■ REVIEW ARTICLE

Establishing Individuality using Palatal Rugae

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ABSTRACT

Palatal rugoscopy is a method to analyze and categorize palatal rugae patterns. These patterns can be analyzed on the basis of its size, shape and quantity in an individual. These patterns turn out to be extremely helpful in the cases when it is difficult to identify an individual with the help of fingerprints or dental records. The review article is based on the study of rugae pattern of male and female on the shapes and to do a comparative analysis of previous data. The present review article highlights the importance of accuracy in using digital software for recording the rugae pattern from photograph of dental casts also it showed that the shape of rugae remained consistent, showing the stability of the rugae patterns which are used for the individual identification.

KEYWORDS | palatal rugae, rugoscopy, biometrics, pre & post orthodontic treatment

dental casts, individual identification

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INTRODUCTION

IDENTIFICATION OF AN INDIVIDUAL IS based on the definition given by Prosthodontic Terms – 8, the muscular folding or wrinkles present anatomically is known as Rugae. These are the folds of connective tissues which are on the preceding third of the palate. The other name for it is "Plica palatine" or "Rugae palatine".

Identification of an individual is of utmost importance to our culture, all the persons have their identity, whether living or dead and the primary motive in Forensic is to establish the identity of an unknown person. The identification of a human individual is based on the scientific facts of DNA analysis, fingerprints and dental records. In an effort to bring about newer methods of personal identification, scientists have highlighted the role of palatal rugae. This study is known as palatoscopy, which helps in the identification of an individual with

the help of palatal rugae. Rugae are irregular in shape, with asymmetric ridges of mucous membrane. It is said that the palatal rugae are stable throughout our lifetime and never undergoes growth, ageing, or any treatment. These patterns occur in the third month of a fetus.[1]

Classifications of Palatal Rugae
Gloria First one to classify these patterns, considered all complex patterns as same. Classification was elementary and the patterns were said to be categorized in two ways: by specifying the extent of zone of rugae and also by specifying the number of rugae.

López De Léon Classification: It determined a link between our personality and these patterns.

Trobo Classification: Divided these patterns as simple, classified and composed rugae.

Carrea Classification: Does not apply any formula and divides the patterns

depending on its type.

Da Silva Classification: Simple and composed rugae types were given in this classification.

Martins Dos Santos Classification: Position and type of the patterns is the base of this classification.

Lysell's Classification: This is the most used classification in research due to its comprehensiveness.

Basauri Classification: It is the easiest classification, similar to Trobo and depicts the variations between innermost and outermost rugae patterns.

Lima: Composite, straight, curved and punctuate are the four types of patterns categorized under this classification system.

Tzatscheva and Jordanov: Branching, direction, radiality and symmetry are the base of this classification.

Cormoy System Classification: The patterns were differentiated based on the size.

Thomas and Kotze Classification: Lysell Classification was its base, but was modified depending on new findings.

Advantages of Rugoscopy

- Rugae patterns are used for identification because they are unique and stable throughout lifetime
- Low utilization cost
- Easy to establish post mortem data with the help of dental records
- Rugoscopy is a simple technique which does not include any complex instruments[2]

METHOD

The dental casts of the palatal rugae patterns were collected. After marking the patterns, they were analyzed using the Thomas and Kotze classification (1983).[3,7,9,12] This particular classification was also used to analyze the patterns on the basis of number, type and unification of the patterns while the shapes were recorded according to Kapali *et. al.* (1997)[16] Dental casts of the patients were collected before and after the orthodontic treatment.

Followed by the marking of the patterns which was then checked for similarity and unification in a family.[4] Dental casts of pre and post-treatment were divided into a group of three random arrangements for which 13 evaluators were selected to find the closest match to known patterns after the patterns were marked with a sharp graphite pencil.[6] Collection of dental casts of pre and post-orthodontic treatment which was later 3D scanned to record the number, strength, characteristics and area of the palate to develop a statistical model and the probability of correspondence.[11] Selection of evaluators to compare the patterns was also used after the digital images of the patterns were marked with a newly designed software Palatal Rugae Comparison Software (PRCS Version 2.0).[5] In the comparison of fingerprints and rugae patterns, the fingerprints were collected on an A4 size sheets and photography of rugae was used. Vucetich's method (1891) was used to analyze fingerprints while the Carrea's classification (1937) was followed for rugae patterns. They were compared using the Chi square test.[8] Fingerprints collected on paper was also analyzed using the Galton's criteria while the alginate impression of the rugae patterns were analyzed following the Kapali's classification. The unpaired t test was used as a statistical tool in the analysis.[17] A laser system was used to scan the maxillary dental casts to record angular, transverse and anteroposterior measures of the palate. The differences in sides and sexual dimorphism were devised using the independent and paired sample t test. The patterns on the collected dental casts were marked and was statistically analyzed using the SPSS 16 software. The Man-Whitney test (1945) was done for pair analysis while the Man-Whitney two tailed test was done on separate gender.[10] SPSS was also used for the statistical analysis of the shape and distance between median and lateral points on first and last patterns on the dental casts.[14] The classification and statistical analysis of the lip prints, rugae and tongue patterns were done. The classification was done using Tsuchihasi

(1970), Lysell (1955) and Stefanescu *et. al.* (1990) and the method of Chi square test was followed for the statistical analysis.[15]

RESULTS

Each research showcased a different result according to the methods adopted and samples taken for the study. It was found that converging type of rugae was more common in females while the circular type of rugae were common in males. The sex prediction by logistic regression analysis (LRA) was found to be 99.2%.[3] When the fingerprints and rugae patterns were analyzed and evaluated, it was found that the external clip was more common on right hand while the internal clip was on the left hand. The Type IV (Carrea classification) rugae which is extended in all direction was found to be more common. While there was significant correlation in fingerprints of and individual, there were no correlation in rugae.[8] A comparison ofrugae in two different genders showcased a greater number of rugae in males and less in females. It was also found that wavy patterns were common in males and straight was common among females.[8,13] It was found that the probability of correspondence of palatal rugae patterns is very low for a palate of six rugae with average palatal area of 1453.9mm2.[11] The medial and lateral points of the first and last two rugae was found to be statistically different.[14] In the analysis of lip prints, rugae and tongue patterns, the type 3 in male and type 1 in female lip prints were more common. In rugae, wave patterns in male and straight patterns in female was more common. The U-shaped tongue in male and V-shaped in female was found to be common.[15] According to the dermatoglyphic study, arch pattern in male and loop in female is more common while according to the rugoscopic analysis straight patterns were frequent in male and circular in female.[17] Rugae established asymmetry laterally in the maximum bilateral measures. In the t-test, males presented the larger value of parameters being 9 out of the complete 28 parameters.[18]

DISCUSSION

All the samples of rugae patterns were different and was stable consistently after orthodontic treatment.[4] The accuracy of the software used for the identification of the individual was found to be 99%.[5] It is well known that the rugae patterns are unique and have negligible differences after any form of treatment. The analysis of the rugae patterns by dental examiners is more efficient and accurate as compared to that of the non-dental examiners.[6] The treatment of extraction decreased the pattern and expansion increased the patterns which was negligible. But the shape remained consistent in all the samples.[7] Based on the geographically different location, even after having statistical difference between genders there were a greater number of total rugae patterns in females as compared to males (It is inclusive of all different types of rugae patterns).[12] In a similar study on two different communities of Kodavas and Tibetans, wave pattern was highest while circular pattern was totally absent. But there was difference in unification of rugae in both communities.[10] Talking about the communities, rugae patterns were significant in western and northern Indian communities. The patterns were significantly different in both the genders.[16]

CONCLUSION

The palatal rugae patterns was found to be unique and can be used as a mode of personal identification with the use of LRA technique.[3] It concludes that no two rugae patterns are similar and possesses unique characteristics.[4,9,10] The computer software was found to be efficient in the rugae analysis. It is proved that the rugae patterns are unique and can be used for individual identification.[5] Dental examiners should be preferred for the evaluation of the rugae patterns as they are more accurate with the analysis. The patterns are unique in every individual.[6] The study showed that the shape of rugae remained consistent, showing the

Classification	Rugae type	Shape
Type A	Point	•
Type B	LINE	
Type C	CURVE	
Type D	ANGLE	
Type E	SINUOUS	
Type F	CIRCLE	

Figure 1:
Trobo classification

CLASSIFICATION	Rugae type
Type I	Posterior-anterior directed rugae
Type II	Rugae perpendicular to the raphae
Type III	Anterior – posterior directed rugae
Type IV	Rugae directed in several directions

Figure 2:
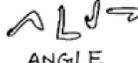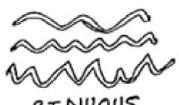Carrea classification

POINT   LINE   CURVE

ANGLE   CIRCLE   SINUOUS

BIFURCATED   TRIFURCATED   INTERRUPT

ANOMALY

Figure 3:
Martin Dos Santos
Classification

stability of the rugae patterns which are used for the individual identification.[7,12] While genetic intervention is the major factor for the correlation in hands, further study will open up more information.[8] The information gathered from rugae patterns can be used for automated biometrics in forensic identification.[11] Palatoscopy can be used as a method of personal identification since it is effective, easy and a stable method.[13] During the maxillary expansion of palate, rugae is stable on the basis of number and shape but is not stable on the basis of position.[14] Lip prints, rugae and tongue patterns are the modes of individual identification which can be further processed with more number of samples.[15] We can also combine the uniqueness of both fingerprints and rugae patterns for the individual identification.[16] Rugoscopy and dermatoglyphics also shows significant differences in males and females and hence can be used for gender identification.[17] The morphometric measurements is also really helpful in the gender identification and sex prediction. Hence, it can also be used with the most common classification.[18] **IJFMP**

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