

Role of Rugae Palatinae in Gender Determination – A Forensic Tool

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Abstract

Introduction: Forensic dentistry has become integral to forensic medicine over the past 100 years. Palatal rugae are the transverse ridges present on the anterior two thirds of the palate on both the sides of the median palatal raphe. Clinically they are seen as irregular and asymmetrical elevations on the mucosa in the midsagittal plane. These transverse palatine folds are well protected by its surrounding structures like the lips, cheek, buccal pad of fat, tongue and teeth in incident of fire and high end trauma .

Aim: The aim of our study was to identify the distribution of specific rugal patterns pertaining to any gender, to assess these parameters during forensic examination.

Methodology: .A total number of 100 patients were taken for the study out of which 50 were males and 50 were females and they were randomly selected from the archives. All subjects were between the age group of 15-24 years. The method of rugae recording used in this study was based on the classification given by Kapali et al. and includes shape and unification of rugae. The shapes of individual rugae were classified as: Straight, Curved, Wavy, Circular, Diverging and Converging.

Result: The study showed that the circular rugae pattern and wavy rugae pattern were higher in males than in females, curve and convergent rugae patterns were higher in females than in males and straight and divergent rugae patterns were equally distributed among males and females.

Conclusion: Our study showed a difference in the prevalence of the rugae pattern between males and females.

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1. Introduction:

The broad range of medical necessity identification methods involve a role played by the discipline of dentistry, which is known as "Forensic Dentistry". A branch of dentistry i.e. Measurable odontology administers the appropriate management, evaluation of dental evidence, proper assessment and the presentation of dental discoveries in light of a reasonable concern for equity. [1]

Scientific Three major uses of odontology include: 1. assessing, diagnosing, and treating wounds of the jaws, soft tissues and a complete dentition of the oral cavity

2. The person's distinguishing evidence, particularly in criminal cases and during major disasters; and

3. Identification, analysis, and evaluation of bite marks from sexual assault, child abuse, and self-defense. [8].

A set of procedures that contribute to the individualization of a person or substance is called identification. Be that as it may, just a single technique can continuously be utilized to conclusively lay out character. Forensic odonto-stomatology or forensic dentistry is the "section of forensic medicine concerned with the proper management, analysis, judgement, and presentation of proof gathered from oral and dental structures in the interest of justice." [2]

Measurable dentistry has turned into an indispensable piece of criminological medication throughout recent years. Forensic odontology is based on the idea that "no two mouths are alike." "[9]

The stomatology component of forensic odonto-stomatology includes the evaluation of rugae patterns. " Palatal rugae are the margins on the first section of the mucosa of hard palate as well as on adjacent side of the mid palatine raphe, and after the sharp papilla." [2]

Unless there is a distinct ossified foundation, the mucosal hard palate exclusively forms the dynamically flowing peaks known as palatal rugae in well-evolved species.

The transverse ridges on the anterior two thirds of the palate on both the sides of the mid palatal raphe are Palatal rugae. Clinically they are seen as irregular and asymmetrical elevations on the mucosa in the midsagittal plane. These transverse palatine folds are well protected by its surrounding structures like

cheeks, lips, buccal fat pad, teeth and tongue in incident of fire and high end trauma.

Allen's initial proposal for the palatal rugae study was in 1889.[3]

Palatal rugoscopy or palatoscopy is the study of the palatal rugae. Identification of human, which is done on systematic principles and involves the use of fingerprints, palatoscopy, dental records, lip prints, and analysis of DNA, is one of the most difficult and demanding subject.[4]

The alternate names of rugae are-"plica palatinae" or "rugae palatine." [5]

Over the course of life, it has been demonstrated that palatal rugae are highly distinct and stable in shape. At the point when recognizable proof of a person by different strategies is troublesome, palatal rugae may in this manner be considered as an elective wellspring of data (normally in the event that similar material is accessible) empowering the hunt field to be limited [1]

Muthu Subramanian et al in his study showed that palatal rugae resists decomposition to a great level. Anatomically rugae are known to branch out from the membrane of incisive papilla which is located posteriorly to the maxillary central incisors, forming a pattern. The pattern of rugae is unique to all individuals. There are 3-7 oblique and transverse ridges present in different shapes. Rugae rarely undergo alteration in shape along with the age or re-emerge after any surgery or trauma.

Changes in the patterns of palatal rugae may be caused by trauma, an extreme habit of sucking on one's fingers, pressure from dentures and orthodontic treatment, and other factors. In a concentrate by Hauser, et al. It has been described that neither time nor age alter the rugae pattern. The direct degree of front rugae doesn't increment following 10 years old as per Van Der Linden. A measureable trademark, for example, shape, unification and bearing stays unaltered all throughout life. It has been demonstrated that patterns between twins are similar but not identical. [5]

The branch of forensic odontology sheds the light on the unique features of the oral cavity in the cases of both criminal and law where the victim is deceased and needs identification when the face is unrecognisable. These attributes of the rugae and the fact that they stay

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preserved throughout life contribute to the area of forensics. Numerous disciplines, including anthropology, orthodontics, genetics, and prosthodontics, have made use of rugae pattern analysis.

Thus in our current study the variety of rugae patterns that are observed on daily basis in the patients and the uniqueness that those carry lead us to explore its distribution and shapes among males and females.

2. Materials and Methods:

The research was done at Karnavati School of Dentistry, in the Department of oral pathology, Karnavati university, Uvarsad, Gandhinagar.

Selection of patients:- A total of 100 patients were used in the study, 50 of whom were men and 50 of whom were women, and they were chosen at random from the archives. All subjects were between the ages of 15 and 24. There were no congenital anomalies, trauma, swelling or undergoing ortho treatment in any of the subjects.

Method of recording rugae:- The classification provided by Kapali et al. served as the foundation for the rugae recording technique used in this study.[6] This classifications include shape and unification of rugae. The observation of rugae was done under bright light and magnification for the most accurate result. A midline was drawn extending from the incisive papilla following the mid palatine raphe to demarcate the right and the left sides. The following shapes were used to classify individual rugae: Straight, Wavy, Curved, Diverging, Circular and Converging.

Straight type had a clear beginning, middle, and end. The curved type had a plain, gently curved crescent shape. When there was proof of even the slightest bend at a rugae's termination or origin, it was considered to be curved. The basic shape of the wavy rugae was serpentine. To be regarded as circular, rugae required a distinct continuous ring formation. When two rugae join at their origin or termination, unification takes place. The term "diverging" refers to unions in which two rugae shared a medial beginning but immediately diverged laterally. Rugae with various starting points medially which joined on their parallel bits were delegated 'merging' [1]

In this review, the optional and fragmentary sorts of

rugae were overlooked when the middle worth of the absolute number of rugae was determined. The collected data were organized and prepared for the Chi-Square test and Fisher's Exact Test and statistical analysis were done.

3. Results:

According to the forms of the rugae, there were comparable disparities in the pattern of rugae between men and women in this study. According to the study, straight and divergent rugae patterns were equally divided between men and women, while the circular rugae pattern and the wavy rugae pattern were more common in men than in women. Curve and convergent rugae patterns were more common in females than in males.

In Table 1, Out of 100 models. The straight pattern was seen equally in male and female subjects. 30 females had this pattern and 30 males had this pattern. Insignificant p value of the chi-square test was 1.000

In Table 2, The curve pattern was seen higher in female subjects, 32 females had this pattern and 28 males had this pattern from the total casts obtained. The prevalence of this pattern was notably higher in females. Insignificant p value of the chi-square test was 0.414

Table 3 shows that there were more male patients (nine out of 100) with the circular pattern than female ones (two out of 100). Males exhibited a markedly stronger variation of this pattern. Significant p value of the chi-square test was 0.025

Out of 100 subjects in Table 4, Male individuals showed the wave pattern more frequently than female subjects did (46 males and 45 females). Males exhibited a markedly stronger variation of this pattern. Insignificant p value of the chi-square test was 0.727

In Table 5, The convergent pattern was seen higher in female subjects, This pattern was present in 25 men and 29 females. Females exhibited this trend to a far greater extent. Insignificant p value of the chi-square test was 0.422

In Table 6, From 100 subjects, The divergent pattern was seen equally 18 females had this pattern and 18 males had this pattern. Insignificant p value of the chi-square test was 1.000

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Table 1. Comparison of Straight pattern between males and females:

Table 1. Comparison of Straight pattern between males and females:							
GENDER	STRAIGHT				TOTAL	CHI SQUARE	P
	ABSENCE		PRESENCE				
	N	%	N	%			
MALE	20	40	30	60	50	0.00	1
FEMALE	20	40	30	60	50		
TOTAL	40	40	60	60	100		

Table 2. Comparison of Curved pattern between males and females

GENDER	CURVED				TOTAL	CHI SQUARE	P
	ABSENCE		PRESENCE				
	N	%	N	%			
MALE	22	44	28	56	50	0.67	0.414
FEMALE	18	36	32	64	50		
TOTAL	40	40	60	60	100		

Table 3. Comparison of Circular pattern between males and females

GENDER	CIRCULAR				TOTAL	CHI SQUARE	P
	ABSENCE		PRESENCE				
	N	%	N	%			
MALE	41	82	9	18	50	5.01	0.025
FEMALE	48	96	2	4	50		
TOTAL	89	89	11	11	100		

Table 4. Comparison of Wave pattern between males and females

GENDER	WAVE				TOTAL	CHI SQUARE	P
	ABSENCE		PRESENCE				
	N	%	N	%			
MALE	4	8.0%	46	92.0%	50	0.122	0.727

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FEMALE	5	10.0%	45	90.0%	50		
TOTAL	9	9.0%	91	91.0%	100		

Table 5. Comparison of Convergent pattern between males and females

GENDER	CONVERGING				TOTAL	CHI SQUARE	P
	ABSENCE		PRESENCE				
	N	%	N	%			
MALE	25	50	25	50	50	0.64	0.422
FEMALE	21	42	29	58	50		
TOTAL	46	46	54	54	100		

Table 6. Comparison of Divergent pattern between males and females

GENDER	DIVERGING				TOTAL	CHI SQUARE	P
	ABSENCE		PRESENCE				
	N	%	N	%			
MALE	32	64	18	36	50	0.00	1
FEMALE	32	64	18	36	50		
TOTAL	64	64	36	36	100		

4. Discussion:

To help in creating a person's individuality, the term palatal rugoscopy or palatoscopy is used to refer to studies of palatal rugae. (6,7) With the small chance of a case where a denture with a name is recovered, it is extremely unusual that an anonymous body would be identified by dental means just from the examination of the corpse. In all other cases, the postmortem results must be compared with some known details about the person suspected of being involved in order to establish identity. As opposed to lip prints, evidence of antemortem of palatal rugae can be found in dentistry through a variety of means, such as dental casts, worn-out maxillary dentures, and intraoral photographs. Palatal rugae patterns can now be thought of as a helpful auxiliary for identification. [7]

100 patients were taken for the study out of which 50

were males and 50 were females and they were randomly selected from the archives. All subjects were between age group of 15-24 years. Males presented with a predilection towards the circular and wavy rugae patterns than females whereas straight and divergent were distributed equally among males and females

Comparison of Curve pattern in both genders: In contrast to Pooja Balgi et al.'s study, the curve pattern in our study was higher in women. [10] whose results were similar Jaisingh et al [4] had also indicated in his study that males had a higher curve pattern, in oppose to our findings. Our study is also contrary to the research done by swabna et al [11] who concluded that the curve pattern were higher in males

Wave pattern compared in men & women:- In our study, we found that men had a higher wave pattern than women, in accordance to the finding of Prathusha

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Subramani et al. [12] who also found that males had a higher wave pattern. Contrary to our study, wave pattern seen more commonly in women according to Harjeet Kaur et al. [7]. Swabna and others [11] Men had a higher wave pattern than women, coinciding with our study.

Assessment based on genders of Unification
Converging pattern:

Unification Converging patterns were more prevalent in females in our study, in accordance to the author Saraf et al. [1] who also found that females exhibit converging patterns more frequently

Comparison of Unification Diverging pattern in both genders:

Contrary to research done by Jaisingh et al. [4] who claimed that diverging patterns were more prevalent in females, our analysis found that unification divergent patterns were equally distributed. In contrast to our findings, Rani.S.Thabitha et al. [13] claimed that males exhibited a greater degree of diverging pattern than females.

In their investigation of the number of primary rugae, Kapali et al. [6] found no appreciable variations between Aboriginal males and girls. The quantity of rugae in the Indian males and girls did not significantly differ, according to the current study.

5. Conclusion:

Our study showed a alteration in the prevalence of the rugae pattern between both the genders where the circular and wavy rugae patterns were less common in the females while less common in the males were curved and convergent rugae patterns. The divergent and straight patterns were observed equally in both genders.

The nature of the palatal rugae to not change through age, chemical injuries, or diseases along with their stable disposition lead them to be the ideal forensic identity marker. Rugoscopy is used along with other identification markers to aid in individual proof of identity in the field of Forensic medicine.

References

[1] Saraf A, Bedia S, Indurkar A, Degwekar S, Bhowate R. Rugae patterns as an adjunct to sex

differentiation in forensic identification. The Journal of forensic odonto-stomatology. 2011 Jul;29(1):14.

[2] Mohan AP, Beena VT, Paul S, Stephen MM, Johnson TK, Mohan R. Assessment of Palatal Rugae Patterns among Different Age Groups: An Institution-based Study. Oral & Maxillofacial Pathology Journal. 2018 Jul 1;9(2).

[3] Balgi P, Bhalekar B, Bhalerao K, Bhide E, Palaskar S, Kathuriya P. Study of palatal rugae pattern in gender identification. Journal of dental and allied sciences. 2014 Jan 1;3(1):13.

[4] Kumar S, Vezhavendhan N, Shanthi V, Balaji N, Sumathi MK, Vendhan P. Palatal rugoscopy among Puducherry population. J Contemp Dent Pract. 2012 May 1;13(3):401-.

[5] Jaisingh R, Deshmukh S, Srilatha KT. Palatal rugae patterns as an adjuvant to gender determination in forensic identification procedures in a paediatric population. J Forensic Sci Criminol. 2016;4(3):1-6.

[6] Kapali S, Townsend G, Richards L, Parish T. Palatal rugae patterns in Australian Aborigines and Caucasians. Australian dental journal. 1997 Apr;42(2):129-33.

[7] Sekhon HK, Sircar K, Singh S, Jawa D, Sharma P. Determination of the biometric characteristics of palatine rugae patterns in Uttar Pradesh population: a cross-sectional study. Indian Journal of Dental Research. 2014 May 1;25(3):331.

[8] Bhateja S, Arora G. Analysis of palatal rugae for human identification in Indian (Mathura) population. Indian Journal of Dental Sciences. 2013 Sep 1;5(3).

[9] Singh K, Anandani C, Bhullar RK, Agrawal A, Chaudhary H, Thakral A. Teeth and their secrets-Forensic dentistry. J Forensic Res. 2012 Jan;3(01):9-11.

[10] Balgi P, Bhalekar B, Bhalerao K, Bhide E, Palaskar S, Kathuriya P. Study of palatal rugae pattern in gender identification. Journal of dental and allied sciences. 2014 Jan 1;3(1):13.

[11] Swabna V, Ramesh M, Rajathi, Ambika, Diana Prem Palatal rugae pattern -a tool in gender determination. International Journal of Basic and Advance Research. 2018; 25(4); 33-42.

[12] Subramanian P, Jagannathan N. Palatal rugoscopy as a method of sex determination in

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forensic science. Asian J Pharm Clin Res.
2015;8(2):136-38.

- [13] Thabitha RS, Reddy RE, Manjula M,
Sreelakshmi N, Rajesh A, Kumar VL.

Evaluation of palatal rugae pattern in
establishing identification and sex
determination in Nalgonda children. Journal of
forensic dental sciences. 2015 Sep;7(3):232.