DOI: https://doi.org/10.53350/pjmhs211592157

ORIGINAL ARTICLE

The Pattern of Palatal Rugae in sub-population of Pakistani adults

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ABSTRACT

Background: Despite the existence of the most reliable and authentic tools of personal identification such as fingerprints, dental, and DNA analysis, the palatal rugae are recommended as an adjuvant aid in forensic diagnosis. Palatal rugoscopy or palatoscopy aims to specify a person's identity and gender discrimination.
Aim: To determine the morphological pattern of palatal rugae considering gender.
Settings and design: Cross-sectional study, calcorrugoscopy, chi-square test
Material: This incorporated 360 subjects encompassing an equal ratio of the male and female genders. Undertaking the inclusion and exclusion criteria of the study, calcorrugoscopy technique was utilized in which maxillary casts were obtained through irreversible hydrocolloid impression material (Cavex cream alginate – fast set) and poured in type III dental stone. The assessed morphological parameters were shape and unification. Trobo's classification and Thomas and Kotze's criteria were used to assess shape and unification respectively to assess the qualitative aspect of palatal rugae. Descriptive analysis was generated in terms of frequencies, percentages, means, and standard deviations.
Results: The most frequently occurred rugae pattern was sinuous followed by a line with divergent unification. Sexual dimorphism was not evident among the selected subjects regarding rugae shape and unification configuration.Moreover, the same trend regarding shape and unification was repeated on both sides of the palate, with no significant difference noted in number of palatal rugae undertaking both sides.
Conclusions: Every individual possesses a unique rugae pattern irrespective of gender.
Keywords: Cross- sectional, Adults, Gender dimorphism, Pakistan, Palatal rugae

INTRODUCTION

The palatal rugae are asymmetric anatomical ridges in the pre-maxillary region that extend behind the incisive papilla. Their study is officially known as palatoscopy or 'Palatal rugoscopy[1].

Its prime significance is in forensic dentistry since they are unique as per individual and may be used as an aid to identify dead bodies or for gender discrimination[2]. Application of palatal rugae patterns for personal identification was first coined by Allen in 1889[3]. They are unique to an individual since they have a higher probability of remaining intact in trauma, incineration, or decomposition[4]. Despite the existence of the most reliable and authentic tools of personal identification such as fingerprints, dental records, DNA analysis; palatal rugae are recommended as an adjuvant aid in forensic diagnosis. It has added on benefits such as its economy, simplicity and reliability[5]. These unique features make palatal rugoscopy an optimum and reliable human identification tool[4].

Many studies have taken place globally on palatal rugaepatterns[5,6,7] Fawzi et al and Gadicherla P et al in their respective studies evaluated the role of palatal rugae application as a tool for gender identification in the Saudi population and appreciated its role in personal identification as well as gender determination. However, the latter research was on 4-16 years old children[5,6]. The more latest research owned by Buyuk SK et al on morphological assessment of palatal rugae incorporated 126 orthodontic casts of Turkish sub-population and revealed that palatal rugoscopy is an authentic tool for forensic diagnosis and gender discrimination.[7]A Pakistani study conducted by Amjad et al shed light on forensic odontology in terms of emphasizing the significance of identification of an individual for legal purposes. This study was carried out on 100 dental maxillary casts and encountered statistically significant differences between males and females in terms of shape, direction, and unification whereas the length of rugae remained the same in both the genders[8].

o the best of our knowledge, there is insufficient available literature on the qualitative aspect of rugae undertaken in Pakistani adult population. There always exists a need for the revision of epidemiological data on regular basis on evolution phenomena. Moreover, this study will be an addition to the baseline statistics of rugae patterns in terms of gender discrimination. Taking gender dimorphism existence with rugae pattern as a null hypothesis, the primary objective of the study was to determine the qualitative pattern of palatal rugae in terms of shape and unification in a sample derived from the Pakistani adult population; and to establish its association with gender.

SUBJECTS AND METHODS

This whole study protocol was approved by the institutional ethical committee possessing clearance number - ERC15/2018.
Inclusion Criteria: Inclusion criteria comprised of male and female adults aged 18 to 55 years following the Declaration of Helsinki 1984.
Exclusion Criteria: Subjects who underwent any surgical procedure involving maxillary arch, orofacial congenital and developmental growth disorders, chronic illness or bony spicules or tori in maxillary arch were excluded.

Received on 23-04-2021
Accepted on 14-08-2021

Settings and execution: This cross-sectional study was managed at Bahria University Dental Hospital, Karachi.
The estimated sample size was 360 computed through an online version of Raosoft calculator employing a non-random sampling technique. Undertaking inclusion and exclusion criteria, subjects were selected according to male and female ratio1:1. Selected subjects were asked to give verbal informed consent upon briefing regarding the study protocol. Demographics of the subjects including age, gender with OPD registration number were recorded on the proforma sheet.
Calcorrugoscopy: Alginate impressions (Cavex cream alginate – fast set) in sterile stock trays were taken of the maxillary arches following the standardized impression taking protocol. The impressions were poured with type 3 dental stone as per manufacture's prescribed instructions. The casts were inspected and if any trapped air bubbles were observed in the anterior third of the maxillary arch, they were excluded and discarded from the sample. All the casts were labeled individually with the patient's OPD number. Black graphite pencil was used to delineate patterns on the cast through naked eye. The single trained examiner was employed to assess and analyze the pattern; and the readings were repeated three times per cast.
Analysis of palatal rugae: The anteroposterior rugae dimension on right and left sides was determined taking the most superior aspect of anterior rugae to the inferior end of the posterior one and thus calculating the mean of both the sides to determine the total anteroposterior coverage of rugae. The anteroposterior dimension was recorded in millimeter using vernier caliper.Trobo's classification with Thomas and Kotze's criteria were used for categorization of shape and unification respectively to assess qualitative aspect of palatal rugae. According to Trobo, rugae were configured into point, line, angle, curve, and sinuous shapes as depicted in figure 1.[9,10] Thomas and Kotze's criteria described the unification pattern as diverging and converging types. The diverging pattern was termed when two rugae arose from the same origin but diverged transversely whereas converging pattern was called in cases when two rugae arose from different regions and converged transversely.
Statistical Analysis: Descriptive analysis of the collected data was generated in terms of frequencies, percentages, means, and standard deviations. Statistical analysis was done using a statistical package of social sciences SPSS Version 21.0.Chi-Square test was employed to assess the relationship between the attributes of rugae pattern and gender. The *p*-value ≤0.05 was considered as the critical value.

RESULTS

Out of a total 360, there were 180 males and 180 female participants. The average age was found to be 34.24±12.78 years. The observed average anteroposterior dimension covered by palatal rugae in males and females was 31.51±8.41mm and 30.76±7.82mm respectively. However, there was a statistically insignificant association noted in anteroposterior dimension of palatal rugae concerning both the genders (*p*=0.33). Regarding the predominant patterns per subject, the most recurring form was sinuous followed by line configuration as shown in figure 2, though the association between the predominant patterns and gender was found to be statistically insignificant.(*p*=0.74)

On analyzing the unification of rugae per candidate, the diverging type was the most prevalent one is depicted in figure 3. However, its correlation with gender was observed to be statistically insignifican (*p*= 0.19)

Upon inspection of the right and left sides of the palatal rugae, 776 and 774 rugae observed on right and left side respectively. The divergent and sinuous types remained predominant patterns on both the sides is summarized in table 1.

Table 1: Comparison between right and left side of rugae patterns in terms of percentages and frequencies (n=1,550)

Patterns	Right side		Left side	
	n	%	n	%
Point				
1	36	10.0	36	10.0
2	4	1.1	5	1.4
3	1 **41**	0.3	0 **41**	0
Line				
1	129	35.8	113	31.4
2	48	13.3	55	15.3
3	25	6.9	21	5.8
4	1 **203**	0.3	5 **194**	1.4
Curve				
1	82	22.8	99	27.5
2	17	4.7	12	3.3
3	12	3.3	4	1.1
4	1 **112**	0.3	5 **120**	1.4
Angle				
1	60	16.7	68	18.9
2	19	5.3	26	7.2
3	7	1.9	7	1.9
4	1	0.3	1	0.3
5	1 **88**	0.3	0 **102**	0
Sinous				
1	95	22.5	83	20.3
2	125	34.7	115	31.7
3	81	22.2	91	25.3
4	27	7.5	23	6.4
5	2	0.6	5	1.4
6	2 **332**	0.6	0 **317**	0
Total	**776**		**774**	

Figure 1:Palatal rugae classification by Trobo.[9,10]

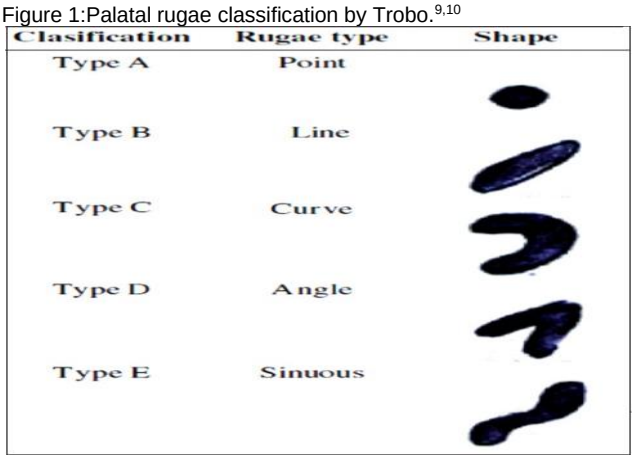


Figure 2: The frequencies of various predominant patterns of rugae.

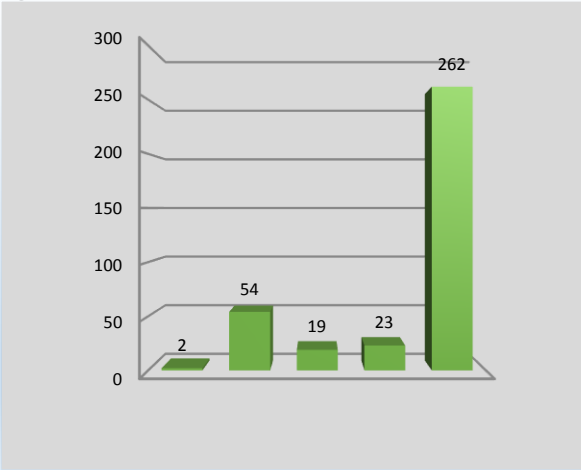
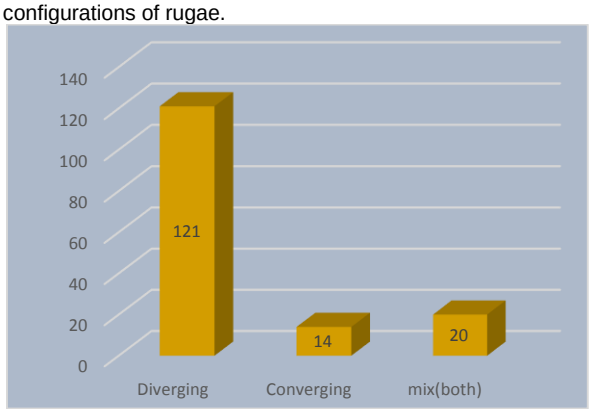


Figure 3: The frequencies of various dominant unification configurations of rugae.



DISCUSSION

The role of quantitative and qualitative aspects of palatal rugae has been substantially involved in personal identification and gender discrimination. Despite the existing comprehensive and complex techniques that include oral photography, calcorrugoscopy, stereoscopy, and stereophotogrammetry; we utilized calcorrugoscopy which involves maxillary positive replicas to study palatal rugae.[9] This is probably the simplest, easiest, and cost–effective approach. However, the subjective approach reflects inferiorly on this method[9,10].

The present study revealed an insignificant difference in the anteroposterior dimension of palatal rugae in males and females. This is in contrast to Savita JK et al who revealed the mean dimensions of rugae in the Indian population from two cities, Kerala and Karnata. The mean dimensions of males were higher than the females in Kerala city whereas in Karnata city, females possessed the higher dimensions than males.[11]Similarly, Pappu BT calculated the individual length of rugae and explored a higher mean length of rugae in males (5.96±0.64) than in females (4.28±0.34).[12] This may be due to a vast disparity seen in the methodology in calculating the palatal rugae dimensions by different investigators. Many researchers had undertaken the individual rugae while others considered the dimension covered by the whole rugae pattern[10,11,12,13]. As far as the present research is concerned, the anteroposterior dimension was determined and a mean value taken from both the right and left sides. The side wise assessment was done from the highest most point of first rugae till the lower most border of last rugae.

Regarding configuration of rugae, the sinuous pattern was turned out to be the highest occurring shape followed by the line without gender discrimination. These findings are quite parallel to the studies done by Srikala P et al who explored sinuous rugae shape was more dominant accompanied by the straight with no gender discrimination[14]. Another study conducted on the Saudi population also revealed sinuous pattern as the most frequent one, but with male gender prominence.The partially compatible study conducted in 2017 by Gadicherla P stated wavy and curvy types of rugae were the most prevalent patterns in Bengaluru population without gender predominance[5]. Another study on the South Indian population showed curved and wavy type of rugae being more prevalent in males and females respectively supporting rugae pattern as an effective gender differentiation tool[15].

While comparing literature related to our population, the present study is partially consistent with research done at Abbottabad which concludes curved pattern as a dominant one with no gender dimorphism[16]. However, Amjad A et al and Hassan N et al reported rugae pattern could be an effective tool in gender discrimination in sub population of Rawalpindi and Karachi[8,17].

On interpretation of the unification of rugae, divergent patterns were found to be more influential yet insignificant association was noted with gender. This is in close accordance with Thabita et al who reported diverging pattern to be more recurring unification but with male predominance.[5,18] In contrast to the result of the present study, Saadeh M et al while studying the morphological features of rugae in the Lebanese adult population explored no unification at all exhibiting no gender discrimination[19]. However, Gadicherla P et al deduced that converging forms were higher in females and diverging forms in males[5]. Sexena ,et al also reported the converging unification being the most predominant one in both males and females[20].

Upon further analysis of the right and left sides of palatal rugae, there was no statistical significance in the total number of rugae on either side with sinuous type being the dominant one. This aspect of the present result is congruent with Shetty KS et al, Wazir SS et al, Gezer R et al who discovered that there was no difference in the quantity of rugae between different races and palatal sides[21,22,23]. Similarly, Paliwal A et al, also supports this finding by exploring sinuous shape as a single configuration of rugae dominating on both sides of the palate[1]. In contrast, Dohke M et al reported side wise variance does exist in relation to number of rugae[24].

The possibilities regarding variations in findings of the present work with those of other studies might be due to the differences in the recruited sample population in terms of ethnicity and regional variations. The disparity and customization of rugae classification system may be the possible confounding variables involved in different

researches underlining this specific topic. Moreover, the present study findings are based upon sample size which is quite greater than that of employed by Gadicherla P et al and Thabita et al each of whom used only 100 maxillary casts. Fahmi et al and Saadeh M et al employed 120 and 217 subjects respectively with the maximum number employed by MM Fawzi who incorporated 300 maxillary models, which is also lower than our sample size.[5,6,17,18,25] Moreover, an equal ratio of male and female samples further authenticates the present study outcomes. However, incorporation of single study venue and hence neglecting the ethnicity and generalizability may affect the reliability of the results. Therefore, the incorporation of different ethnic groups will result in being more representative of the whole Pakistani population for future research work.

CONCLUSION

The present research concludes that every individual has a unique rugae pattern irrespective of gender. The overall most frequently occurring rugae pattern were sinuous and line with divergent unification. This trend in pattern and unification was also observed on both the sides of the palate. Moreover, there is no significant difference noted in terms of number of palatal rugae on both sides of the palate.

Source(s) of support: nil

Conflicting Interest (If present, give more details): There are no conflicts of interest.

Contribution of authors: FH: Refining the study concept and design, Data acquisition, Theory development, **AB:** Data interpretation, Manuscript writing, **FI:** Critical analysis and final approval of the manuscript, **SH:** Supervision, Conceptualization and designing of methodology, **FJ:** Data acquisition, literature search, **AA:** Data acquisition and statistical interpretation.

Ethical policy and Institutional Review board statement: Patient declaration of consent statement: not applicable

REFERENCES

1. Paliwal A, Wanjari S, Parwani R. Palatal rugoscopy: Establishing identity. J. Forensic Dent. Sci. 2010;2(1):27.
2. Bansode S, Kulkarni M. Importance of palatal rugae in individual identification. . J. Forensic Dent. Sci. 2009;1(2):77.
3. Harrison A. The palatal rugae in man. ProcAcad Nat Soc. 1889;6:245.
4. Sheikhi M, Zandi M, Ghazizadeh M. Assessment of palatal rugae pattern for sex and ethnicity identification in an iranian population. J. Dent. Res. 2018;15(1):50.
5. Gadicherla P, Saini D, Bhaskar M. Palatal rugae pattern: An aid for sex identification. J. Forensic Dent. Sci.2017;9(1):48.
6. Fawzi M, Eldomiaty M, Desouky M, Algaidi S. Evaluation of the role of palatal rugae application as a tool for sex identification in the Saudi population. WIMJ Open. 2016 ;3(1):28-31.
7. Buyuk SK, Simsek H, Yasa Y, Genc E, Turken R. Morphological assessment of palatal rugae pattern in a Turkish subpopulation.Aust J Forensic Sci. 2019;51(1):40-8.
8. Amjad A, Hussain S, Rehman A, Hassan SH. Role of palatal rugae pattern in forensic identification of individuals.POJ.2016;8(2):104-8.
9. Jindal V, Mahajan A, Mahajan N, Goel A, Kaur R, Puri C. Rugae pattern determination in periodontitis patients: A descriptive study.JICDRO. 2016;8(2):115.
10. Hermosilla VV, San Pedro VJ, Cantín LM,Suazo GIC. Palatal rugae: systematic analysis of its shape and dimensions for use in human identification. Int. J. Morphol.2009; 27(3):819-825.
11. Savita JK, Kumar BY, Satish G, Divya KT, Ranjitha J, Pujari RK. Prevalence of palatal rugae shapes in Karnataka and Kerala population: A cross-sectional study.JISPCD. 2016 May;6(3):230.
12. Pappu BT, Gopinathan TA, Naduvakattu B. Assessment of different palatal rugae patterns in gender identification. Int. J. Oral Care res. 2018;6(3):17.
13. Said KN, Khalid AS, Farook FF. Distal extension of palatal rugae as a limitation for donor soft tissue grafts in a Jordanian population: A cross-sectional study. BMC Oral Health. 2021 Dec;21(1):1-7.
14. Srikala P, Shivakumar P, Amol S, Karishma M, Gaurav K,Gauri B. comparison of palatal rugae with direct and indirect blood grouping. EJPMR.2017;5(2);301-08.
15. Nallamilli SM, Tatapudi R, Reddy SR, Chennoju SK, Kotha R, Kotha P. Diversity of palatal rugae pattern and their reliability in sex discrimination in a south Indian population. J Indian Acad Oral Med Radiol. 2015;27:09-12.
16. Jadoon OK, Zaman MU, Zaman FU, Khan D, Farooq U, Seema N, Ahmed I. Analysis Of Palatal Rugae Pattern In Population Of Abbottabad: A Forensic Study.JAMC. 2018 ;30(3):428-31.
17. Hassan N, Phil M. Assessment of Reliability of Rugoscopy for Identification of Gender. JPDA. 2019 Jul;28(03):114.
18. 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. J. Forensic Dent. Sci. 2015;7(3):232.
19. Saadeh M, Ghafari JG, Haddad RV, Ayoub F. Palatal rugae morphology in an adult mediterranean population. *J Forensic* Odontostomatol . 2017;35(1):21.
20. Saxena E, Chandrashekhar BR, Hongal S, Torwane N, Goel P, Mishra P. A study of the palatal rugae pattern among male female and transgender population of Bhopal city. Journal of forensic dental sciences. 2015 May;7(2):142.
21. Shetty KS, Kalia S, Patil K, Mahima VJ. Palatal rugae pattern in Mysorean and Tibetan populations. Ind J Dent Res. 2005;16:51–5.
22. Wazir SS, Arora P, Srivastava R, Rastogi S. Forensic application of palatal rugae in dental identification. JNMAJ Nepal Med. Assoc. 2015 Jul 1;53(199):151-5.
23. Gezer R, Deniz M, Uslu AI. Morphological characteristics and individual differences of palatal rugae. Journal of Craniofacial Surgery. 2019 Sep 1;30(6):1906-10.
24. Dohke M, Osatio S. Morphological study of the palatal rugae in Japanese 1. Bilateral differences in the regressive evaluation of the palatal rugae. .*Jap J Oral Biol* 1994; 36:125–140.
25. Fahmi FM, Al-Shamrani SM, Talic YF. Rugae pattern in a Saudi population sample of males and females.*Saudi* Dent J. 2001;13:92–95.