

COMPARISON OF PALATAL RUGAE PATTERN BETWEEN DENTATE AND EDENTATE PUNJABI POPULATION

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Abstract:

Context (Background): Palatal rugae are asymmetric ridges of dense connective tissues extending laterally, on both sides, from the incisive papilla and the anterior part of the median palatine raphe. The characteristic uniqueness and genetic basis of the palatal rugae suggest their use in person's identification. Once formed in 3rd month in uterus, palatal rugae do not undergo any change except in length, due to normal growth. However, some events can contribute to changes in palatal rugae.

Aim: The aim of this study was to compare the palatal rugae pattern in dentulous and edentulous groups.

Methods & Material: A total of 40 maxillary casts equally distributed between, dentulous and edentulous groups were observed for number, length, shape, unification and direction of all palatal rugae.

Results: Palatal rugae pattern were found to be shorter in length and lesser in number and complexity in edentulous patients than those in dentate group.

Conclusion: Palatal rugae pattern undergo changes with aging and loss of teeth, hence limiting their role in post-mortem identification of the edentulous deceased.

Keywords: Dentulous and edentulous casts, forensic, palatal rugae, Punjabi population.

Introduction:

Forensic identification by its nature is a multidisciplinary approach relying on positive identification methodology as well as presumptive or exclusionary methodologies which deals with proper handling and examination of dental findings. (1) Proper identification of the deceased is very important to claim certification of death and for personal, social and legal reasons. The various identification methods employed in forensic odontology include bitemarks, photographs, radiographs, molecular methods, cheiloscopy and rugoscopy.(2)When identification of the deceased gets difficult due to adverse situations, the palatal rugae can be considered as an alternate source for identification. (3)

Palatal rugae also called plicae palatinae, transverse and rugae palatinae are asymmetrical and irregular elevations of the mucosa in the anterior third of the palate, arranged in transverse direction from the palatine raphe located in the mid-sagittal plane. (4) Palatal rugae had been applied in various fields such as anthropology, genetics, comparative anatomy, forensic odontology, prosthodontics and orthodontics. (5) They were first described by Winslow in 1753 but the use of palatal rugae pattern for person identification was first suggested by Allen in 1889.(6) Kuppler in 1897, was the first person to study the palatal anatomy for identifying various races. However, the term rugoscopy (palatoscopy) was first proposed by Trobo Hermosa in 1932. (5)

Once formed in 3rd month in uterus, palatal rugae do not undergo any change except in length, due to normal growth. However, some events can contribute to changes in palatal rugae including extreme finger sucking in infancy and persistent pressure with orthodontic treatment or dentures. Controversy still exists about the stability of quantitative and qualitative characteristics of palatal rugae during growth, orthodontic treatment with and without teeth extraction or as a result of edentulism. (4) These changes led us to compare rugae pattern between dentulous and edentulous subjects.

Methods & Material:

The study sample consists of 40 maxillary casts obtained from the alginate impressions of the subjects in dentate (20) and edentulous (20) groups. The impressions were poured with dental stone. The inclusion criteria for the dentulous and edentulous groups were young healthy subjects with bilateral class I occlusion (age group: 21-27 years; which represents within the age of growth completion) and completely edentulous patients with atleast 1 year of edentulism (so that the changes could be detectable) respectively. Any subject with previous craniofacial trauma, surgery or orthodontic treatment and edentulous patients with inflammation in the oral cavity were excluded from the study.

Casts were analysed for number, length, shape, unification and direction of all palatal rugae. Total number of rugae were counted on both sides, rugae lengths were recorded and two categories were formed; primary rugae $\geq 5\text{mm}$ and secondary rugae $< 5\text{mm}$. Their shapes were classified into four major types; straight, curved, wavy and circular. (Figure 1,2) Unification occurs when two rugae are joined at their origin or termination. Unifications in which two rugae began from the same origin but immediately diverged were classified as diverging. Rugae with different origins which joined on their lateral portions were classified as converging. (Figure1)Rugae converged medially and diverged laterally were classified as converged – diverged. The direction of each main primary rugae was determined by measuring the angle between the line joining its origin and termination and a line perpendicular to the median palatine rugae. Forward – directed rugae were associated with positive angles, backward – directed rugae with negative angles and perpendicular rugae with angles of zero degrees.

Results:

Descriptive statistics for the number of rugae and the qualitative characteristics (shape, unification and direction) of dentate and edentulous groups and comparisons between them are illustrated in Table 1.

Significant differences were observed between the 2 groups. In edentulous group, the number of total and primary rugae (7.45 and 6.6 respectively) was significantly lesser than those of dentate

subjects (9.65 and 8.65 respectively). Comparing the qualitative characteristics of the palatal rugae between the two groups, the complex rugae patterns (wavy and circular) in dentate group were greater than those in edentulous ones. The most common rugae pattern in the dentate group was wavy followed by curved, straight and circular pattern while the edentate group showed a predominance of curved pattern followed by wavy and straight with the total absence of circular pattern. In edentulous group, there was a decrease in the length of the palatal rugae and were positioned more laterally and anteriorly in comparison to those in dentulous group.

Discussion:

Rugae have been used in medico-legal identification processes because their individual morphological characteristics are stable over time.(7) Studies undertaken to determine the thermal effects and the decomposition changes on the pattern of palatal rugae have concluded that most burn victims with panfacial third degree burns did not bear any palatal rugae pattern changes and when changes were noted, they were less evident than the generalized body state. However, researchers have disagreed as to whether or not legal identification could be based solely on palatal rugae. Controversy also exists about the stability of quantitative and qualitative characteristics of rugae during growth. (8)Kapali et al have stated that dentures, malpositioned teeth and palatal pathologies can cause alterations in rugae patterns. (9)

The present study showed significant reduction in total rugae number and number of primary rugae in edentulous group which was consistent with the results obtained by Lysell who concluded that the number of rugae decreased from 23 years of age onwards. (10)Kamala et al noted that mean number of rugae showed a slight decreasing trend with increasing age. (11) Similar results were also obtained by Jawad in Iraqi population. (4)In contrast, Hauser et al had suggested that the mean rugae count changes moderately in adolescence and then increases significantly from the age of 35 to 40 years. (12)

It has been suggested that changes in the length of rugae with age result from underlying palatal growth. Furthermore, Bailey et al, Almeida et al and Abdel-Aziz et al concluded that movement of teeth may change the position of the rugae points. (8) Jawad found shorter length of rugae in edentulous palates when compared to dentate group. (4) This was in concordance with the results of the present study which showed that there was decrease in the length of the palatal rugae and positioned more laterally and anteriorly in comparison to those in dentulous group. In contrast, Kapali et al in their study concluded that the length of rugae increased significantly till 10 years of age thereby remaining stable throughout life. (9)

In our study, the most common rugae shapes were wavy and curved, whereas straight and circular types were least common regardless of age. The edentulous group showed the highest mean of curved pattern and total absence of circular pattern suggesting the presence of simpler form of rugae pattern. Forward, backward and perpendicular was the descending manner of rugae direction in both groups. Another complex figure of rugae pattern is the unification. It was clear that this perplexity of rugae pattern in dentate individuals tend to regress in edentulous group. The above results were consistent with the studies of Jawad and Rajguru et al. (4, 5)

Ohtani et al stated that in edentulous patients, features like poorly demarcated eminence of rugae and non-complex rugae pattern are mainly due to the shape of the edentulous palate itself and rarely due to the dentures and could lead to difficulties in finding unique points for personal identification. The continuous mechanical stimulation can result in much morphological degeneration in the palatal mucosa involving rugae. (13) Bailey et al observed that the significant changes occur in the rugae position especially at their lateral ends which were believed to follow the direction of teeth migration; a physiological process that occurs after loss of adjacent teeth, in connection with the bone resorption at the maxillary arch circumference. (14) Jawad in his comparative study evaluated that the distance between the medial rugae points and incisive papilla appear to be reduced in the edentulous group. Also, the distances between medial rugae ends and median palatine raphe increase in

edentulous palates, suggesting that the palatal rugae begin to degenerate and shorten in length from their medial ends.(4)

In the available English literature, only two studies have compared the rugae pattern in dentulous and edentulous groups. No previous study has involved Punjabi population. So, more investigations are required with larger sample size to evaluate whether palatal rugae identification can play a definite role in forensic science.

Conclusion:

The statistically significant changes were observed in number, shape and direction of rugae in edentulous subjects as compared to dentates. The continuous mechanical stimulation by the denture can result in morphological degeneration in the palatal mucosa involving rugae. Thus, palatal rugae pattern undergo changes with aging and loss of teeth, hence limiting their role in post-mortem identification of the edentulous deceased.

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Figure 1: Palatal rugae on dentulous maxillary cast; (A) Circular, (B) Convergent, (C) Divergent

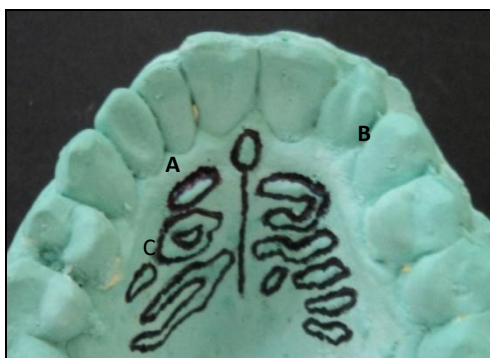


Figure 2: Palatal rugae on edentulous maxillary cast; (A) Straight, (B) Wavy, (C) Curved



Table 1: Descriptive statistics of number and qualitative characteristics of palatal rugae in dentulous and edentulous subjects

Dentate	Total rugae	Primary rugae	Secondary rugae	Curved	Wavy	Straight	Circular	Divergent	Convergent	Forward	Backward	Perpendicular
Mean	9.65	8.65	.95	3.40	5.55	0.60	0.10	.80	.40	5.80	2.35	1.50
SD	1.46	1.59	.87	2.03	1.43	.82	.44	.69	.68	1.36	1.18	1.00
p value	0.000	0.000	0.000	0.000	0.000	0.004	0.330	0.000	.017	0.000	0.000	0.000

Edentate	Total rugae	Primary rugae	Secondary rugae	Curved	Wavy	Straight	Circular	Divergent	Convergent	Forward	Backward	Perpendicular
Mean	7.45	6.60	.85	4.45	2.25	.75	.00	.10	.00	0.60	0.24	0.16
SD	1.14	.88	.81	1.27	1.29	.71	.00	.30	.00	.49	.43	.36
p value	0.000	0.000	0.000	0.000	0.000	0.000	-	0.163	-	0.000	0.000	0.000

Table 2: Documented studies on palatal rugae in the English literature.

Year	Author	Findings
1997	Kapali et al ⁹	Length of rugae increased with increase in age, number remains constant and most common shapes were wavy and curved.
2005	Shetty et al ¹⁵	A statistically significant association between the total number of rugae and the gender in Mysorean and Tibetan populations. Parameters like the length and shape of the rugae showed racial differences.
2007	Nayak et al ¹⁶	Wavy and curved forms were most common. Palatal rugae shape revealed significant differences between the two Indian populations.
2008	Ohtani et al ¹³	In edentulous subjects; eminences of rugae were poorly demarcated and were non complex.
2009	Hermosilla et al ¹⁷	Most prevalent shape was sinuous followed by curve, number non significantly higher in males and maximum rugae were found to be present between the mesial and distal surface of second premolar.
2010	Paliwal et al ¹⁸	Predominant pattern was wavy followed by curved.
2010	Jawad ⁴	In edentulous subjects, number and length of rugae decreased with non complex rugae pattern and positioned more anteriorly and laterally.
2011	Shukla et al ⁸	Although some changes do occur in the rugae during orthodontic treatment the morphology of palatal rugae remains stable throughout life and may be important for identification where there is antemortem information available for comparison.
2012	Indira et al ¹⁹	Each individual had different rugae pattern including dizygous twins and the rugae patterns were not symmetrical, both in number and distribution
2013	Shubha et al ²⁰	Percentage of curve shape and backwardly directed rugae was more in North Indians as compared to South Indians who had wavy shape in common with forwardly directed rugae.
2014	Rajguru et al ⁵	Similar rugae pattern between male and female dentate population while there is varied pattern between the sexes of edentulous population. The most predominant patterns were straight, wavy, and circular patterns.
2014	Mohammed et al ²¹	The wavy and curved rugae pattern were predominantly followed by straight rugae in males; whereas in females, wavy and straight rugae were prevalent followed by curved rugae.
2014	Present study	Rugae were reduced in number, length, showed lesser complexity and positioned more laterally and anteriorly in edentulous subjects.