Rugae pattern in a sample of population of Meerut – An institutional study

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Abstract

Context: Many studies on rugae pattern have been done on various samples of population, but no study has so far been done to assess the rugae pattern of population of western Uttar radesh, especially Meerut. **Aims:** This study was aimed to assess the rugae pattern in males and females of a sample of population of Meerut, which may be an additional method of determining gender when dealing with any crime or with mutilated bodies that have undergone damage beyond recognition. **Settings and Design:** A total of 100 Class I dentulous subjects, 50 male and 50 female patients reporting to the outpatient department of Kalka Dental College, Meerut, Uttar Pradesh were randomly selected with an age range between 20-30 years. Exclusion criteria were subjects >14 years of age, congenital malformations, previous orthognathic surgery, allergy to impression material, bony and soft tissue protuberances, active lesions, deformity or scars and trauma of the palate. Prior approval from the Institutional Ethical Committee was taken. **Subjects and Methods:** Alginate impressions of palate of selected patients were poured in dental stone and rugae pattern was identified and analyzed by a single rater employing Thomas and Kotze's (1983) method. **Statistical analysis used:** Two-sample *t*-test and Chi-Square tests were used for comparison of means and relationship between the attributes. A significance level of 5% was considered as critical value. **Results:** No significant difference was noted in total number or length of rugae between the genders. However, statistically significant difference in the circular type in males and converge type in females was observed. **Conclusion:** Rugae pattern can be used as a method of differentiation between males and females to corroborate the findings of other methods such as anthropometric evaluation of the cranium and dental characteristics.

Key words: Forensic identification, palatine rugae, rugae pattern, rugae, rugoscopy

Introduction

Rugae are defined, according to Glossary of Prosthodontics Terms,[1] as anatomical folds or wrinkles; the irregular ridges of folds of fibrous connective tissue located on the anterior third of the palate behind the incisive papilla. Rugae patterns have been studied for various purposes primarily in the fields of comparative anatomy, anthropology, genetics, orthodontics and prosthodontics.[2,3] In forensic medicine, the chief methods of identification are fingerprints, DNA comparison and dental characteristics. Many times, one or all of these methods may not be totally effective or conclusive in establishing identity[4] especially where human identification methods are compromised as in cases of severe burns, accidents etc., Many victims of serious crimes and those of aircraft accidents[5,6] have been identified by their dentition.[7,8] Here palatal rugoscopy can be used as

a necro identification technique.[9] Rugae are protected from trauma by their internal position in the head and are insulated from heat by the tongue and the buccal pads of fat.[10] Studies have demonstrated that no two palates are alike in their configuration[11] and that the characteristic pattern of the palate does not change as a result of growth.[12] Even amongst the twins, studies have indicated that the patterns are similar but not identical.[13] Differences between genders using study of rugae pattern have been studied without any conclusions till now.[9] The aim of this article is to study the rugae pattern in a sample of male and female population of Meerut, and to compare the patterns between the two groups, which may be an additional method of determining gender.

Subjects and Methods

Subjects for this study were randomly selected from the outpatient's department of Kalka Dental College, Meerut, Uttar Pradesh. For the purpose of this study a total of 100 Class I dentulous subjects, 50 males and 50 females were selected after determining the sample size by performing power analysis in G*Power 3, a software package for power analyses. The ages of the subjects were between 20-30 years with a mean of 24 years. A prior approval from the Institutional Ethical Committee was taken. The exclusion criteria were subjects below the age of 14 years, congenital malformations, previous orthognathic surgery, allergy to impression material, bony and soft tissue protuberances, active lesions, deformity or scars and trauma of the palate. After obtaining informed consent, alginate impression of maxillary arch was made and the study models were prepared in dental stone for interpretation. The rugae were highlighted using a black permanent marker [Figure 1] and recorded by one rater according to the classification given by Thomas and Kotze[14] as it was found to be the most practical and easiest to apply compared with other methods such as those of Houser et al.,[15] and of Reuer.[16] Thomas

and Kotze classification system includes number, length, shape and unification of rugae. The shapes are classified into curved, wavy, straight and circular [Figure 2]. Fragmented rugae are those which have length less than 5 mm. Straight types run directly from their origin to insertion [Figure 2]. The curved type has a simple crescent shape with a gentle curve [Figure 2]. Wavy rugae are serpentine in shape [Figure 2] and rugae that showed definite continuous ring formation were classified as circular [Figure 2]. Additionally, non-specific rugae pattern was observed, which did not fall in any of the mentioned classes. Unification is divided into converge when two rugae originate away from the center and unite towards it [Figure 2] whereas diverge ones are those rugae which originate from the center and diverge away from it [Figure 2]. All the identification and measurements were done by one examiner and the readings were repeated three times for each cast. A percent agreement of 87% was obtained during the recording of readings. In this study, the fragmented type of rugae of a size less than 5mm was ignored, when the mean value of the total number of rugae was calculated. The fragmented types were studied separately for a comparative study purpose between males and females.

Two-sample t-test and Chi-Square tests were used for comparison of means and relationship between the attributes. A significance level of 5% was considered as critical value.

Results

The total number of rugae and the mean value for males and females is illustrated in Table 1. The distribution of different types of rugae in males and females were statistically analyzed and illustrated in Table 2. There was a statistically significant difference in the converge pattern of rugae which was found to be higher among females than males ($P < 0.05$). There was also a statistically significant difference in the circular pattern of rugae which was higher in males than females ($P < 0.05$). Distribution of the length of rugae was noted and statistically
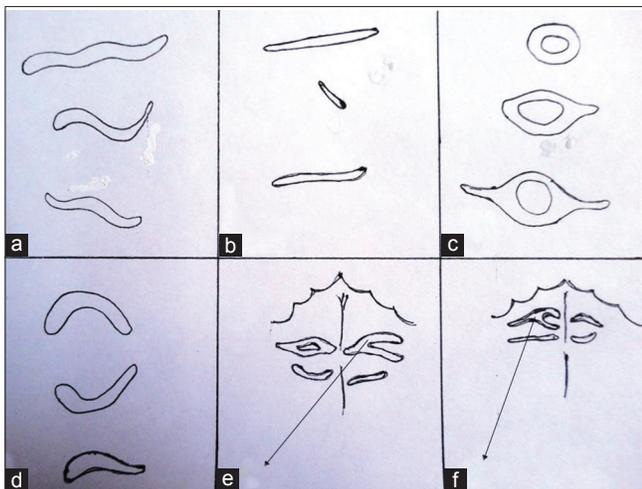
Figure 1: Sketch depicting classification of palatal rugae based on Thomas and Kotze's system

Figure 2: Cast shwoing the tracing of pattern of palatine rugae

analyzed [Tables 3 and 4]. The Chi-square and *t*-tests showed no significant difference between the genders.

Discussion

Palatoscopy or palatal rugoscopy has its origin in 1932, and its discovery is credited to Troban Hermaso, a Spanish investigator.[17] Palatal rugoscopy is the study of palatal rugae in order to establish a person's identity.[2,18] The anatomical position of the rugae in the mouth remains unchanged in its position throughout life, withstands disease, chemical aggression and trauma. It is stable and resists decomposition for up to seven days after death.[19,20]

Table 1: Mean and standard deviation of total number of rugae in males and females

Sex	Total	Total no. of rugae	Mean	SD
Male	50	352	7.04	0.90
Female	50	340	6.8	0.88

SD: Standard deviation

Table 2: Statistical analysis of % of different types of rugae in males and femals

Rugae pattern	Sex	No. of cases	Mean	SD	P value	Statistical significance
Curve	M	50	21.75	11	>0.05	NS
	F	50	20	12.75		
Wavy	M	50	37.83	11.5	>0.5	NS
	F	50	36.41	15.41		
Converge	M	50	7.16	10.33	<0.05	HS
	F	50	12.58	12.03		
Diverge	M	50	1.5	4.83	>0.05	NS
	F	50	1	3.58		
Circular	M	50	4.83	8.42	<0.05	HS
	F	50	1.42	3.83		
Straight	M	50	10	9.17	>0.05	NS
	F	50	11.68	10.5		

NS: Not significant, HS: Highly significant

Table 3: Distribution of the length of rugae in males and females

Sex	No. of cases	Fragmented >5 mm (%)	From 5-10 mm (%)	<10 mm (%)	Total
Male	50	47 (11.43)	187 (45.49)	177 (43.06)	411
Female	50	52 (12.65)	177 (43.06)	183 (44.53)	412

Table 4: Comparison of difference in the length of rugae (mm) between males and females

Type of rugae	Sex	No. of cases	Mean	SD	P value	Statistical significance
Fragmented	M	50	1.14	0.91	>0.05	NS
	F	50	1.31	1.11		
Between 5-10 mm	M	50	3.13	0.85	>0.05	NS
	F	50	2.79	1.05		
<10 mm	M	50	2.95	0.875	>0.05	NS
	F	50	3.19	1.0		

NS: Not significant

Rugoscopy is an auxiliary method to identify humans used when other identification methods commonly used are unviable, like in the case of carbonized bodies.[20] In such instances, palatal rugae are the more preferred means of identification because of their low cost of utilization, ease of use, and reliability of method. They are sufficiently characteristic to discriminate between individuals because no two palates are alike in their configuration. This finding has been substantiated by results obtained in similar studies conducted earlier.[9-11,19,25]

In the field of forensic odontology, rugoscopy is still in its infancy. A consensus of opinion is emerging that the rugae remain fairly stable in number and morphology.[20,21] Its design and structure are unchanged and are not altered by chemicals, heat, disease or trauma, or, if palatal rugae are destroyed, are reproduced exactly on the same site that had these rugae.[3,15,20] Many studies have been carried out on the rugae patterns in black, Caucasian and mixed populations in South Africa,[22] Japan[23,24] Saudi Arabia[25] and parts of India.[17,26] Differences between genders using study of rugae pattern have been studied without any conclusions.[9,22] Differences in the shape of the palatal rugae in different races and population have been investigated but no significant sex differences were observed in those studies either.[22,26] However, no study has so far been done to assess the gender differences in the shape of palatal rugae especially among the western Uttar Pradesh population, more specifically in Meerut. Our study did not show any significant difference in the number of rugae between the males and females. Results from our study mostly conform to the results presented by Dohke and Osato[24] as well as Faisal M Fahmi *et al.,*[25] who indicated that among the Japanese as well as the Saudis, females had fewer rugae than males. A significant difference was found in two shapes of rugae in our study. Primarily, the converge pattern of rugae was found to be higher in females than males. This difference was found to be statistically significant. The other finding was that the circular pattern of rugae was found to be statistically higher in males than in females. These two differences could be employed as factors for identification along with other methods of identification.

In the light of these results, we strongly suggest that palatal rugae pattern can be used in forensic science as an auxiliary method for estimating gender. However, a more detailed study involving a larger sample size is needed in order to substantiate these findings. In addition, examining the rugae patterns in other population samples in India may further corroborate our findings.

Conclusion

The present study attempted to compare the rugae pattern between males and females in a sample of population of Meerut. No significant difference was noted in total number of rugae between males and females. However, statistically

significant differences were found in the two patterns of rugae; the converge type was found to be higher in females and the circular type was found to be higher in males. The rugae pattern can thus be utilized as a useful additional method for estimating gender. However, further research with larger sample sizes may be needed to substantiate these findings.

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