Research Article

Comparison of Palatal Rugae Pattern among North Indian, South Indian and Chinese Students of Manipal University

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ABSTRACT

Aims: To compare the palatal rugae pattern for possible differences between North Indian, South Indian and Chinese students of Manipal University, Manipal. To determine the rugae length, shape, direction, unification and number of the primary rugae.

Materials and Method: The study sample consisted of 50 diagnostic study models of 25 males and 25 females within the age group of 15-23 years that were available in the department and were free from palatal defects. These cases were further segregated into 10 cases of each of North Indian, South Indian and Chinese groups and their dental casts were analyzed.

Results: There were no significant differences in any parameter when compared between the sexes in the three groups. The difference in length among 3 groups was not statistically significant. The most common rugae shapes observed were wavy and curved. The North Indian group had a predominantly curved rugae shape while the South Indian and Chinese groups had wavy rugae. The rugae direction observed was mostly forward. Most of North Indians and South Indians had forward rugae and Chinese group had both types.

Conclusion: The present study indicated that the rugae patterns of the Chinese group are significantly different from the two Indian groups and can hence be used for group identity.

Keywords: Forensic dentistry, India, Chinese.

INTRODUCTION

The most common role of a forensic dentist is the identification of deceased individuals. A methodological and systematic identification of each tooth and surrounding structures helps in natural and mass disaster situations. Because of the lack of a comprehensive fingerprint database, orofacial identification continues to be crucial.

Palatal rugae are the soft tissue ridges present on the anterior palate behind the incisive papilla on either side of the median palatine raphe. They retain their shape throughout the life[1,2,3].

The palatal rugae are unique and stable landmarks that can serve as fingerprints, which are specific to different racial groups[4-10]. They have been used for forensic identification and in many other fields.

Table 1: Inter group comparison of rugae length.

Group	N	Mean	SD	P value
South Indians	10	13.28	2.29	
North Indians	10	13.74	2.21	0.6
Chinese	10	12.53	3.36	

Table 2: Inter group comparison of rugae shape.

Group	Curved	Wavy	P value
South Indians	2(20%)	8(80%)	
North Indians	6(60%)	4(40%)	0.03
Chinese	0 (00%)	10(100%)	
total	8(26.7%)	22(73.3%)	

Table 3: Inter group comparison of rugae direction.

Group	Forward	Backward	P value
South Indians	9(90%)	1(10%)	
North Indians	7(70%)	3(30%)	0.254
Chinese	5(50%)	5(50%)	
total	21(70%)	8(26.7%)	

Table 4: Inter group comparison of rugae unification.

Group	Diverged	Converged	Negative	P value
South Indians	4(40%)	1(10%)	5(50%)	
North Indians	5(50%)	1(10%)	4(40%)	0.053
Chinese	8(80%)	2(20%)	0(0%)	
total	17(56.7%)	4(13.3%)	9(30%)	

Table 5: Inter group comparison of rugae number.

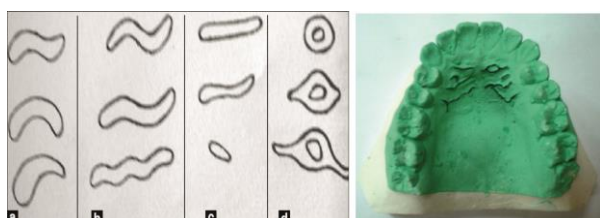| Group	Median	Percentiles			P value
		25th	50th	75th	
South Indians	4	4	4	5	
North Indians	4	4	4	4	0.004
Chinese	3	3	3	3	

Fig 1: Classification of rugae based on shape a) curved b) wavy c) straight d) circular.

Fig 2: The rugae direction determination on casts.

Fig 3: Palatal rugae unification on casts.

MATERIALS AND METHODS

The study was conducted at the Department of Orthodontics, Manipal College of Dental Sciences, Manipal University, Manipal. Fifty diagnostic study models of 25 males and 25 females in the age group of 15-23 years available in the department and free from palatal defects were used in the study. These cases were further segregated into 10 cases of each of North Indian, South Indian and Chinese groups.

The rugae patterns on the study models were delineated using 0.1 HB graphite pencil under adequate light and magnification using hand lens. Measurements were made directly from the cast using digital slide calipers with an accuracy of 0.01 mm from the origin near the mid-palatine raphe to

the terminal end transversely. The dental casts were analyzed according to the classification described by Thomas and Kotze in 1983[11]. The rugae were categorized as: primary [>5 mm], secondary [3-5 mm] and fragmentary [<3mm]. The primary rugae were considered for further analysis. The shape, direction, unification and number of the primary rugae were recorded. For sake of uniformity, the left half of the palate was chosen for the analysis.

Four major types of rugae shapes were identified (Figure 1):

- Curved - a simple crescent shape which was curved gently
- Wavy- serpentine form
- Straight - runs directly from the origin to termination
- Circular- a definite continuous ring formation (diameter from the origin to termination was considered)

The rugae direction was determined by the angle between the two lines:-The line joins the origin and termination of the rugae, and the line perpendicular to the median palatal raphe. Based on this, three angles were determined (Figure 2):

- Positive angles - forwardly directed rugae
- Negative angles – backwardly directed rugae
- Zero angle – perpendicular rugae

Palatal rugae unification was said to have occurred when two rugae joined at their origin or termination (figure 3):

1. Diverging: If two rugae had the same origin from the midline but immediately branched.
2. Converging: Rugae had different origins from midline, but joined on their lateral portions.

Statistical Analysis

All data were separated according to the group and sex. The differences in rugae patterns between groups and sexes were analyzed using SPSS version 14.0. One-way ANOVA test was used to compare the rugae length. The shape, direction and unification were compared by Chi-square test and the number was compared by Kruskal-Wallis test, between the different groups. The p value less than 0.05 was considered significant.

RESULTS

The present study was an attempt to determine the rugae length, shape, direction, unification and number of the primary rugae. There were no significant differences in any parameter when compared between the sexes in the three groups. The differences in length among 3 groups were not statistically significant (Table 1).

The most common rugae shapes observed were wavy and curved. Straight and circular shapes were not seen. The North Indian group had a predominantly curved rugae shape while the South Indian and Chinese groups had wavy rugae (Table 2).

The rugae direction observed was mostly forward. Most of North Indians and South Indians had forward rugae. Chinese group had both types (Table 3).

The overall sample as well as the individual groups had a predominantly diverging unification of rugae (Table 4).

The two Indian groups showed four primary rugae but the Chinese group predominantly showed three (Table 5).

DISCUSSION

The characteristic pattern of the palatal rugae does not change as a result of growth and remains stable from time of development until the oral mucosa degenerates at death[12,13]. Events such as trauma, extreme finger sucking in infancy and persistent pressure from orthodontic treatment and dentures can contribute to the change in rugae patterns[1,14]. Changes in rugae form seen in diseases, chemical aggression or trauma are less pronounced than those seen in the generalized body state. The palatal rugae have the ability to resist decomposition for up to seven days after death[4].

Researchers had found difficulty in the task of classification of the rugae patterns due to the subjective nature of observation and interpretation within and between observers. Numerous classifications have been devised by several authors to record the palatal rugae patterns and amongst all, Silva[15,16], Lysell[1], Thomas and Kotze[11,16,17] classifications are often used in

recording the patterns. Thomas and Kotze in their literature highlighted the difficulties in observing, classifying and interpreting the limitless and minute variations in palatal rugae and emphasized the necessity for standardizing the procedures in recording. After a thorough review on all classifications from the literature, the method of identification used in this study (Thomas et al, 1983) was found to be the most practical and easy to apply compared with other methods.

According to Thomas 1983[11], palatal rugae do not undergo any changes except in length, throughout a person's life. Van der Linden in 1978[18] also stated that the changes in the length of rugae with age result from underlying palatal growth. The anterior rugae do not increase in length after 10 years of age. The mean rugae count and other qualitative characteristics such as shape, direction and unification remains unchanged throughout the life[1,19,20]. In contrast, Lysell in 1955[1] stated that the number of rugae decreased from 23 years of age onwards. Hence, in the present study the age range of 15 to 23 years was considered.

In the present study, the length of palatal rugae does not vary in this age group and among the three groups. This is consistent with earlier studies of Lysell L (1955), Hauser et al (1989), Dohke (1994) and Kapali et al (1997)[1,14,19,21]. This variable may therefore lack the specificity for race categorization.

In the present study, there were no significant quantitative and qualitative differences found in rugae pattern between males and females. Earlier studies of J.D. Simmons et al (1987), Kapali S (1997) found gender differences to be inconclusive[20,21].

Wavy rugae shapes were most commonly observed in the present study followed by curved shape. Circular and straight shapes were not seen in our study. All 10 Chinese and most South Indian subjects showed wavy pattern while in North Indian population mostly curved form was observed. According to Thomas and Kotze (1983), rugae shape is a discrete variable, which provides better results than using continuous variables like rugae measurements. It retains its shape throughout the life[2,3,22].

The forward-directed rugae (70%) were found to be more common than the backward-directed rugae (26%). The present study failed to reveal a significant difference among the three population groups, in rugae direction. Lysell in 1955[(1)] stated that there is a tendency for the backward direction of rugae to decrease with age, due to an increase in the width of the palate and forward movement of the teeth in relation to the rugae, resulting in rugae being located in a wider and shallower part of the palate than originally. Another possible explanation given for this tendency is the forward movement of lateral parts of the rugae in connection with forward growth of the dental arch. This indicates a high percentage of rugae moving in a posterior direction in Aborigines. In our study, there is significant difference in ethnicity. Dohke and Osato stated that the rugae direction is influenced by the formation of the dental arch associated with replacement of teeth, growth and developmental changes in the palate[14].

In the total, 70% of unification was found whereas 30% showed no unification. Divergent type of unification was most commonly seen in Chinese students. The differences found between two Indian sub populations were not significant. Kapali et al 1997 in their study of rugae patterns in Australian Aborigines and Caucasians failed to indicate any difference in unification. The present study has shown that the tendency for unification to be more in Chinese individuals suggesting that the rugae unification is unique to certain populations[21].

The mean number of primary rugae is found to be four in Indian sub populations and three in Chinese. Analysis of number of rugae in different population groups can be a valuable parameter in rugoscopy. Interracial differences in rugoscopy and palatoscopy have been established for identification of individuals by C.J. Thomas et al in1983 and Kapali S in 1997[17,21].

More studies are required to verify these findings due to the limited sample size in this study.

CONCLUSION

The uniqueness and overall stability of palatal rugae suggests their use as a viable alternative for forensic identification in different groups. The present study indicates that the rugae

patterns of the Chinese group are significantly different from the two Indian groups, and can hence be used for group identity. However, these interpretations are precluded by the small sample size and further research work on larger samples is required to validate its use in forensic application.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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