

Dimensional analysis of various rugae patterns in north Indian population subset

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Abstract

Introduction: Rugae patterns are significant markers for analyzing anteroposterior changes in adolescence, and forensic investigations. **Aim:** The purpose of this study was to ascertain the gender-wise predisposition of rugae patterns and to analyze anteroposterior alterations along with any developmental changes in palatal depth. **Materials and Methods:** One hundred pre-treatment study cast models were obtained from the archives of the Department of Orthodontics, M.M. CDSR, Mullana. Parameters employed were: Division of medial palatal region into "a": Distance between incisive papilla length and anterior limit of the anteriormost rugae; "b": Distance between incisive papilla and most posterior rugae limits; measurement of Lateral rugae dimensions and palatal depth. Statistical analysis: Mean $\pm$ S.D. values were obtained and 'P' values calculated. **Results:** Comparison of "a" and "b" showed a significant difference in the P values between the age-groups 12-13 years and >14 years. Rugae patterns with separate origins showed a predisposition for female gender. **Conclusion:** A significant change in the anteroposterior medial rugae dimensions was seen in adolescent age groups alongside no variation in palate depth. Hence, it can be concluded that differential growth potential is present in the premaxilla and can cause shift in medial palatal dimensions without altering the rugae patterns and palatal depth.

Key words: Forensic odontology, gender, medial palatal region, rugae patterns

Introduction

Palatal rugae are irregular, asymmetric ridges of mucous membrane extending laterally from the incisive papilla and the anterior part of the median palatal raphe. These structures have been used as internal cast reference points for quantification of tooth migration. A few investigators have shown the medial rugae region to be stable or show predictable changes post orthodontic therapy. The rugae patterns are completely formed by

the 12th to 14th week of prenatal life and remain stable thereafter. These are unique to each person and show distinctiveness based on ethnic groups and hence are useful in forensic identification. Because they are stable landmarks the palatine rugae play a significant role in clinical dentistry as well. The objective of this study was to analyze and characterize the rugae patterns, compare the rugae dimensions in various age groups and to ascertain any relationship between dimensional analysis and palatal depth.

Materials and Methods

Cross-sectional casts of 52 females and 48 males were selected from the archival section of the Department of Orthodontics, M. M. College of Dental Sciences and Research, Mullana (Ambala) and studied employing following parameters:

1. Assessment of age (according to erupted teeth).

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2. Gender differentiation (based upon records).
3. Division of medial palatal region into:^[1]
 - i. "a": Distance between incisive papilla length and anterior limit of the anteriormost rugae.
 - ii. "b": Distance between incisive papilla and posteriormost rugae limits.
 - iii. Lateral rugae dimensions.
4. Palatal depth (measured from healthy gingival margin underneath the mesiolingual cusp to the deepest concavity of the palatal arch using a brass wire between two opposing points and measuring the vertical distance at the center).
5. Rugae patterns.^[1]

No patient details were disclosed and ethical guidelines as per the Declaration of Helsinki were followed.

Statistical analysis

The rugae patterns were quantified according to percentage distribution based upon gender predilection. Correlations among "a", "b", lateral rugae patterns and palatal depth were calculated by mean $\pm$ S.D. followed by evaluation of 'P' values.

Results

The rugae patterns identified were: common origin; separate origin; lateral branching; secondary rugae and fragmentary patterns. Females were found to have slightly higher predilection towards having the common, fragmentary and lateral branching rugae patterns. There was a stronger female predisposition for rugae with separate origin, whereas, the secondary rugae were equally existent in either gender.

Significant correlation was found between the 'a' ($P=0.03$) and 'b' values ($P=0.02$) on comparing the mean $\pm$ S.D. values of age groups between 12-13 years and >14 years, respectively. Hence, there is a corresponding anteroposterior increase in palatal dimensions in these age groups [Table 1]. This study showed no changes in the lateral rugae dimension and palatal depth with increasing age. The majority of the study cohort (57%) had a palatal depth in the range of 1.6-2.0 cm [Table 2].

Discussion

Palatal rugae have been used as reference points for many purposes such as evaluating tooth movement pre- and post-orthodontic treatment, population studies and forensic identification. Stability of medial palatal region has been a subject due to differences among various investigators. Christou and Kiliardis evaluated the vertical changes in the medial aspects of the rugae and concluded that these changes over time are due to the alterations in the vertical positioning of maxillary incisors and increase in lower face height. Growth periods (12-13 years and >14 years) studied in this paper, showed a downward and forward movement of the maxilla in relation to the cranial base and also, changes in the size and shape of maxilla by structural remodeling. These phenomena can be explained by the deposition of new bone on the oral surface of the palate and at the alveolar crest. Therefore, the changes in rugae dimensions can be the result of this differential growth in the palate and alveolar crest.^[2-4]

Rugae patterns showed a strong female predilection for rugae with separate origins [Figure 1] whereas slightly higher incidences were noted for rugae with common origin, fragmentary and lateral branching patterns. There was an equal percentage of gender with secondary rugae



Figure 1: Photograph depicting rugae patterns with secondary origin and fragmentary nature

Table 1: Gender-wise percentage population distribution

Common origin		Lateral branching		Fragmentary		Separate origin		Secondary rugae	
Males (%)	Females (%)	Males (%)	Females (%)	Males (%)	Females (%)	Males (%)	Females (%)	Males (%)	Females (%)
48.43	51.56	48.57	51.42	45.33	52	37.14	60	50	50

Table 2: Percentage distribution between various parameters

'a'		'b'		Lateral rugae		Palatal depth	
Dimensions	% Distribution	Dimension	% Distribution	Dimension	% Distribution	Dimension	% Distribution
≤ 0.8 cm	7	≤ 1.6 cm	6	≤ 0.8 cm	5	≤ 1.5 cm	36
0.9 – 1.3 cm	69	1.7 – 2.0 cm	42	0.9 – 1.3 cm	79	1.6 – 2.0 cm	57
> 1.4 cm	10	2.1 – 3.0 cm	42	> 1.4 cm	10	> 2.0 cm	9

pattern in the ethnic segment of north Indian population studied [Table 1].

The purpose of this paper was to evaluate a cross-sectional patient database to analyze the anteroposterior stability of the medial rugae region. Analysis of 100 study casts showed a significant difference in the medial rugae region ($P=0.03, 0.02$) in 'a' and 'b' values. No significant changes were noted in the lateral rugae dimensions. The palate growth in this period was found to be non-significant. Hence, it can be surmised from the analysis of the results that there is a differential growth spurt in the anterior and posterior palate during adolescence as is marked by the significant differences in the measurement values obtained through this study.

Conclusion

Palatal rugae can be studied as a strong indicator of ethnicity, gender differentiation and study of growth changes in

the anterior maxilla. Thus, rugae are important tools in clinical investigations involving forensic anthropology and developmental biology.

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