



The association of palatal rugae with Angle's Malocclusion among males and females - A retrospective study

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Abstract

Introduction: The psychological, esthetics and treatment benefits of malocclusion can be achieved early, if the early diagnosis can be achieved based on the knowledge of palatal pattern and orientation among males and females. The primary aim of the study was to evaluate the association between palatal rugae pattern and dental malocclusion of Angle's class I, class II and class III.

Material & Methods: For the current cross sectional study, dental cast of 150 patients with good quality alginate impressions of both the arches were selected. Group 1, 2 and 3 consisted of Angle's Class 1, 2 and 3 malocclusion, respectively. All three groups consisting of 50 subjects which were equally divided among male (and female. A sharp HB pencil was used to highlight its pattern and measured using vernier.

Results: Statistical analysis was done by using descriptive and inferential statistics using chi-square test and Kruskal Wallis test. The result obtained is conclusive of secondary rugae having no significant difference in terms of right and left rugae i.e. symmetry was present. Contrast results were observed for primary rugae. The patterns of palatal rugae among males and females showed no statistical significance difference with wavy pattern to be slightly more associated among females with class 3 malocclusion.

Conclusion: The findings of the present study are suggestive of presence of slight variation in primary palatal rugae along with its right and left asymmetry.

Keywords: Dental Cast, Palatal rugae, Malocclusion

INTRODUCTION

The palatal rugae, the generally transverse ridges situated in the anterior part of the palatine mucosa, are widely present in mammals, but their biological significance is little understood. They are distinct structures that remain in the same position and pattern throughout an individual's life. This gives them a unique function in forensic dentistry, with possible consequences for human identity.¹ They are employed in orthodontics as reliable reference landmarks for superimposition of pre- and post-treatment cephalometric tracings.²

During the third month of intrauterine life, palatal rugae develop and cover the majority of the length of the palatal shelves. These structures are represented by a series of anatomical folds in the front section of the palatal mucosa, behind the incisive papilla on each side of the median palatal raphe.³ They occur before the fusion of the palatine shelves and range in number from 4 to 6. The interplay between epithelial and mesenchymal cells regulates their growth and development. By the conclusion of intrauterine life, the pattern becomes uneven, with the posterior ones

disappearing and the anterior ones becoming more prominent.⁴⁻⁵

Palatal rugae appear in the third month of intrauterine life and develop completely during the same time period, whereas dental malocclusions appear several years later. Malocclusion results in functional damage and cosmetic problems, as well as long-term psychological effects.⁶ The importance of early diagnosis has been emphasized since it may provide an advantage to interceptive or preventative therapy. As a result, the burden of illness and duration of treatment may be reduced. It follows a common signaling pathway during craniofacial development, and because it is a stable landmark, its connection with Angles classes of malocclusion might be beneficial for predicting impending dentoskeletal abnormalities.⁷⁻¹⁰

A review of the relevant literature revealed that, sparse data indicating the relationship of palatal rugae with different malocclusions is available.¹¹ This study was thus aimed at examining the association of palatal rugae with the grades of Angle's malocclusion.

Material & Method:

For the current cross sectional study, dental cast of 150 patients reporting to Department of Orthodontics and Dentofacial Orthopedics, V.S.P.M. Dental College and Research Centre were taken into consideration. The good quality alginate impressions of both the arches were selected from patients who reported to the department in the last three years. The entire study was conducted over a period of 3-6 months.

Subjects ranging between 18 – 30 years of age with full permanent dentition, well-established molar and incisor relationships and a good-quality pretreatment dental casts were suitably included for this retrospective study. Whereas, those with unmatched molar-incisor relation, quarter or half-cusp molar relation or any other anomaly were excluded from the study.

The primary aim of the study was to evaluate the association between palatal rugae pattern and dental malocclusion of Angle's class I, class II and class III. The 150 dental cast were therefore divided into 3 groups. Group 1, 2 and 3 consisted of Angle's Class 1, 2 and 3 malocclusion, respectively. All three groups

consisting of 50 subjects which were equally divided among male (25) and female (25).

In order to study and record the palatal rugae pattern, a sharp HB pencil was used to highlight its pattern as observed in figure 1. In addition, the medial and distal most ends were marked and measured using vernier caliper to assess the distance. Based on Hauser et al's¹² observations of palatal rugae, the pattern and orientation was assessed. The right and left side prevalence of palatal rugae pattern and its association with Angle's class 1, 2 and 3 were evaluated. The primary and secondary palatal rugae were noted. Three anterior rugae, also known as primary rugae, were recorded and labeled as rugae 1,2 and 3. Based on length, the rugae were categorized as primary (> 5 mm), secondary (3 – 5 mm) and fragmentary type (< 3 mm).



Fig 1: Primary rugae marked using a sharp HB pencil

The data recorded was tabulated into excel sheets and subjected to SPSS tool for statistical analysis. Statistical analysis was done by using descriptive and inferential statistics using chi-square test and Krushkal Wallis test and software used in the analysis were SPSS 24.0 version and GraphPad Prism 7.0 version and $p < 0.05$ is considered as level of significance.

Result:

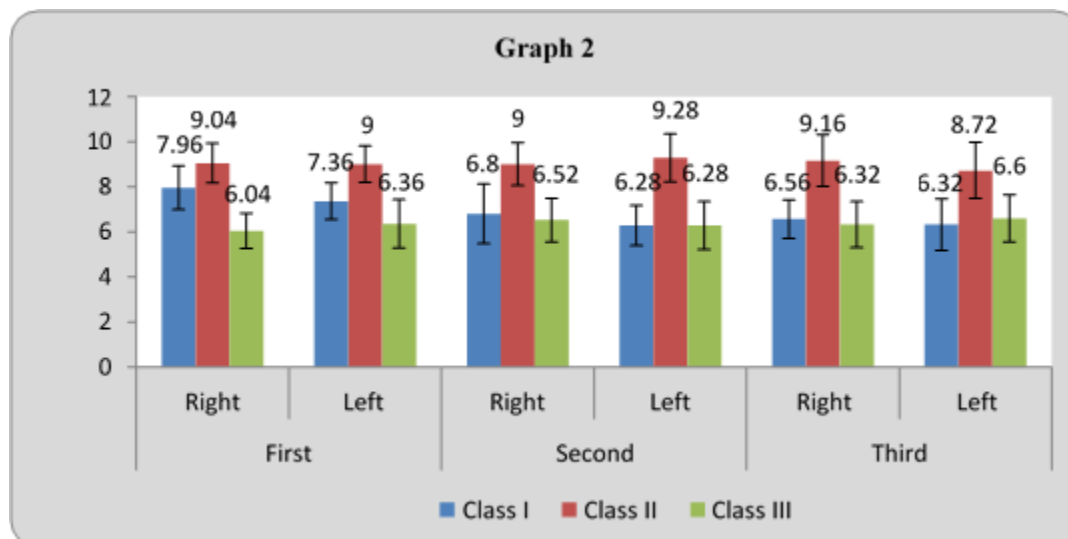
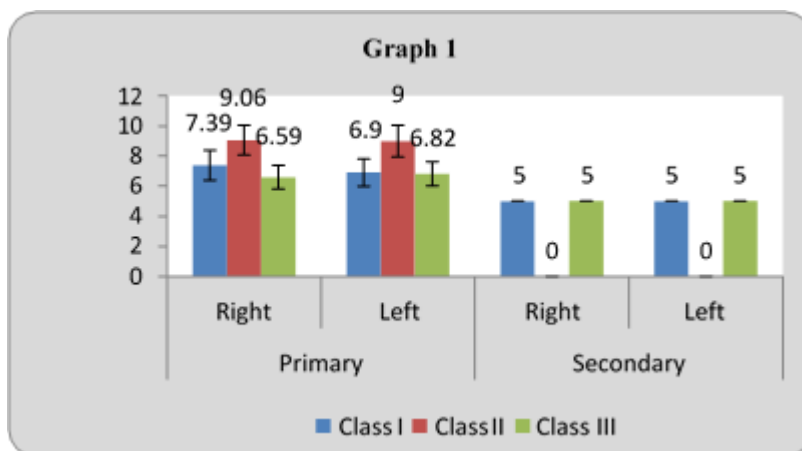
The right and left distribution of palatal rugae assessed are tabulated in table 1. There was no significant difference observed in terms of secondary rugae distribution of right and left side, whereas, the primary rugae showed statistical significance difference. The difference is graphically represented in graph 1. The primary rugae marked as first, second and third showed statistical significance ($p = 0.0001$) among all three classes (Graph 2). The result obtained is

conclusive of secondary rugae having no significant difference in terms of right and left rugae

i.e. symmetry was present. Contrast results were observed for primary rugae.

Table 1: Mean number of palatal rugae among malocclusion group

		Class I	Class II	Class III	z-value	p-value	
Primary	Right	7.77±1.40	7.39±1	9.06±0.99	6.59±0.78	114.23	0.0001*
	Left	7.67±1.40	6.90±0.91	9±1.06	6.82±0.81	107.72	0.0001*
Secondary	Right	5±0	5±0	0±0	5±0	-	-
	Left	5±0	5±0	0±0	5±0	-	-
First	Right	7.68±1.52	7.96±0.97	9.04±0.88	6.04±0.78	49.26	0.0001*
	Left	7.57±1.41	7.36±0.81	9±0.81	6.36±1.07	47.00	0.0001*
Second	Right	7.44±1.55	6.80±1.32	9±0.95	6.52±0.96	40.01	0.0001*
	Left	7.28±1.73	6.28±0.89	9.28±1.06	6.28±1.06	73.85	0.0001*
Third	Right	7.34±1.63	6.56±0.86	9.16±1.14	6.32±1.02	59.56	0.0001*
	Left	7.21±1.56	6.32±1.14	8.72±1.24	6.60±1.04	32.80	0.0001*



The patterns of palatal rugae among males and females showed no statistical significance difference when curved, straight and wavy patterns were assessed among angle's class 1, 2 and 3 cast. Table 2 notably observed wavy pattern to be slightly more associated among females with class 3 malocclusion.

Pattern	Class I		Class II		Class III	
	Male	Female	Male	Female	Male	Female
Curved	9(36%)	8(32%)	10(40%)	7(28%)	9(36%)	6(24%)
Straight	8(32%)	7(28%)	8(32%)	7(28%)	8(32%)	5(20%)
Wavy	8(32%)	10(40%)	7(28%)	11(44%)	8(32%)	14(56%)
Total	25(100%)	25(100%)	25(100%)	25(100%)	25(100%)	25(100%)
χ^2 -value	5.72, p-value=0.82, NS, p>0.05					

Table 3 highlights the results of rugae orientation. The anteriorly directed, horizontal and posteriorly directed rugae orientation showed no statistical significance (p=0.29) in first primary rugae. There was significant difference observed in second primary rugae (p=0.0001) and third primary rugae (p=0.038).

	Class I		Class II		Class III		χ^2 -value
	Male	Female	Male	Female	Male	Female	
First							
Anteriorly Directed	5(20%)	1(4%)	8(32%)	3(12%)	7(28%)	3(12%)	11.79 p=0.29
Horizontal	2(8%)	2(8%)	1(4%)	2(8%)	2(8%)	4(16%)	
Posteriorly Directed	18(72%)	22(88%)	16(64%)	20(80%)	16(64%)	16(64%)	
Second							
Anteriorly Directed	1(4%)	5(20%)	3(12%)	6(24%)	11(44%)	3(12%)	36.41 p=0.0001*
Horizontal	22(88%)	16(64%)	10(40%)	7(28%)	8(32%)	12(48%)	
Posteriorly Directed	2(8%)	4(16%)	12(48%)	12(48%)	6(24%)	8(32%)	
Third							
Anteriorly Directed	5(20%)	3(12%)	8(32%)	3(12%)	5(20%)	2(8%)	19.12 p=0.038*
Horizontal	1(4%)	0(0%)	5(20%)	0(0%)	3(12%)	2(8%)	
Posteriorly Directed	19(76%)	22(88%)	12(48%)	22(88%)	17(68%)	19(72%)	

Discussion:

The palatal rugae play a major role in mastication, and speech. In most of the incidences, the tip of tongue is in contact with primary palatal rugae. This could be one of the important findings linking the association of palatal rugae with malocclusion. The current retrospective study assessed 150 cast of both males and females. The findings of the current study showed slight asymmetry in primary rugae patterns and symmetry in secondary rugae patterns. However, both supporting and contrast, studies can be found in literature. These studies have evaluated different populations, genders and geographic variation.13-15 The current study was conducted in Nagpur city of

Maharashtra, India and found no statistical significant difference in males and females.

The number, shape and direction of palatal rugae have been shown to represent strong hereditary predisposition.16, 17 The orientation of the initial palatal rugae was observed to differ significantly. Previous research found no variations in the direction of main palatal rugae which is in accordance with present study.4 It might be because the rugae are asymmetrical and the mechanism of their growth and establishment are poorly understood.18 These results show that advances in orofacial complex structures are mutually linked and can be vulnerable to comparable epigenetic changes which can affect the phenotype of

each other. Further analysis of genetic variants on the molecular level can demonstrate that this link is a gold standard.

The literature presented many approaches for the assessment of dental palatal rugae. Optocom software, Reflex metrograph, photos and photocopies of dental cast have been utilized in the past for the assessment of palatal rugae.18-22 Each of these approaches demands a specialized tool, gadget or software which many researchers and physicians do not obtain. Kapali et al²³ and Moran et al²⁴ measured palatal landmarks with a vernier caliper. In the current study, a digital vernier caliper was employed because it is simple to use and can be used directly on a dental cast, eliminating the need for cast digitization and specialized knowledge.

Within the limitation of the study, the psychological, esthetics and treatment benefits of malocclusion can be achieved early, if the early diagnosis can be achieved based on the knowledge of palatal pattern and orientation among males and females. However, larger sample size study are recommended to yield effective clinical relevance.

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