Morphology of Palatal Rugae in Various Sagittal Skeletal Malocclusions in Kerala Population- A Retrospective Study

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Abstract

The present study was designed evaluate the structural morphology of palatal rugae in Kerala orthodontic subjects with varying Sagittal Skeletal Malocclusions. Pretreatment maxillary casts of 105 patients were analyzed for rugae patterns qualitatively and quantitatively using modified Thomas and Kotze classification. The data were statistically analyzed. According to the Fishers exact test, the most common type of rugae pattern in all the groups (Class I, Class II, and Class III) were observed to be wavy followed by curved. Skeletal Class III had the highest number of straight rugae 71.4% among the three groups which was statistically significant. Direction of rugal alignment was horizontal and droplet-shaped incisive papilla was identified among different skeletal dysplasia groups.Palatal ruage may serve as valuable indicators for population identification and help in facial reconstructions through their association with varying skeletal malocclusions.

Keywords: *Palatal Rugae Pattern, Skeletal Malocclusion, Dental Casts, Forensic Dentistry*

Introduction

The irregular asymmetrical palatine folds on the anterior third of the palate are called as palatal rugae. They possess unique individualistic morphologic characteristics that are helpful in population identification and are stable over time.[1, 2]

In a county like India where usable dental anthropological data is sparse palatal rugae could be valuable for forensic identification due to racial specificity, facilitating population identification and post- mortem identification.

Rugae are classified based on their length, shape, direction of alignment, unification or branching number distributed on either side of the median palatal raphae. The plica palatinae are thus assessed qualitatively and quantitatively based on these parameters.

Studies have shown the uniqueness of the rugae when assessed in various populations and may be helpful in individual identification and population identification.[3- 7]

Stability of palatal rugae, pre and post orthodontic treatment have made them reliable markers of identification. Studies have also attempted to establish the relation of palatal rugae pattern and various dental malocclusions, thereby allowing for early intervention and prevention of dento-skeletal issues.[8, 9]Astudy was conducted to investigate morphological structure of palatal rugae in Turkish orthodontic subjects with various sagittal skeletal malocclusions, concluded the uniqueness of rugae morphology in relation to skeletal dysplasia.[10]

No study has been conducted on individuals with various sagittal skeletal malocclusions in Indian population with varying ethnicities. The purpose of this study was to evaluate the morphological structure

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of palatal rugae in Kerala orthodontic subjects with different sagittal skeletal malocclusions.

The objective of the present study was to evaluate and compare the structural morphology (number, pattern, direction of alignment) of palatal rugae and shape of the incisive papilla in Kerala orthodontic subjects with varying sagittal skeletal malocclusions i.e. Skeletal Class I, Skeletal Class II and Skeletal Class III.

Material and Method

The study was designed to be a retrospective study. Pretreatment records i.e lateral cephalograms and maxillary casts of 105 subjects age ranging 18-25 years, were procured from the archives of the department. Records of patients with any congenital deformity or history of palatal surgery and previous history of orthodontic treatment were excluded. The maxillary models whose palatal rugae were clearly visible were selected.

Methodology

The subjects were grouped into Class I, Class II, Class III (n=35 each) according to the ANB angle measured on lateral cephalometric radiographs. (Class I ANB angle 0º to 4º, Class II ANB angle >4º and Class III ANB angle <0º).

The maxillary casts were numbered. A midline was drawn coinciding with that of the mid palatine raphae extending from the incisive papillae to the posterior most extent of the rugae dividing the palate into right and left halves. The outlines of the rugae were traced using graphite pencil under adequate illumination. The rugae were then measured and categorized as primary, secondary and tertiary rugae and assessed for different patterns. Modified Thomas and Kotze[11] method was used for quantitative and quantitative assessment. The number, pattern, direction of rugae alignment and shape of the incisive papilla were assessed among all the groups.

Statistical Analysis

All data were analysed using IBM SPSS software VERSION 22.0. The Kruskal–Wallis test was used to compare the number of primary palatal rugae (PPR) among the groups.Fishers exact test was used to compare the pattern of rugae between the various skeletal malocclusions on both sides of the palate and the direction of rugae among the groups. Chi square test was used to compare the shape of the incisive papilla among the groups. P values of less than 0.05 were considered statistically significant.

Results

Kruskal- Wallis test analyzed the primary palatal rugae (PPR) quantitatively and compared among the groups on the right and left side of the palate. As regards to the number of PPR on the left and right sides, there was maximum number of primary palatal rugae on the right side of subjects with and Skeletal Class II (mean 3.86right and 3.80 left) and Skeletal Class III (mean 4.17 right and 3.97 left) in comparison with Skeletal I(mean 3.54 right and 3.60 left) with the highest number of primary rugae in Skeletal Class III on the right side among the groups, which was statistically significant (p value 0.003) (Table 1).

Table 1: Kruskal Wallis test showing the number of primary palatal rugae (PPR) among the groups

Primary	Class	N	Mean (SD)	Range	Median (Q1-Q3)	Chi square value	p-value
Right	**Class 1**	35	3.54 (0.61)	2 - 5	4(3 - 4)	11.90	0.003*
	Class 2	35	3.86 (0.65)	3 - 5	4(3 - 4)		
	Class 3	35	4.17 (0.79)	3 - 6	4(4 - 5)		
Left	**Class 1**	35	3.60 (0.55)	3 - 5	4(3 - 4)	4.33	0.12(NS)
	Class 2	35	3.80 (0.58)	3 - 5	4(3 - 4)		
	Class 3	35	3.97 (0.89)	2 - 6	4(3 - 5)		

N=Samples In Each Group*p<0.05 statistically significant,

Wavy and curved types were the most common types of rugae pattern in all skeletal dysplasia groups. On the right side (Class I,93%wavy and 31.4%curved, Class II,91%wavy and 51.4% curved, Class III,80%wavy and 65.7%curved).Followed by straight and unification pattern. Skeletal Class III had the highest number of straight rugae 71.4% among the three groups which was statistically significant (p value 0.00) (Figure 1). On the left side of the palate Wavy pattern was the most common pattern in all malocclusion groups (Class I, 94.3%wavy, Class II 94.3%wavy, Class III, 77.1%), but this was not statistically significant.Followed by curved, straight and unification pattern. Skeletal Class III had the highest number of straight rugae 62.9%among the three groups which was statistically significant (p value 0.003). (Figure 2)

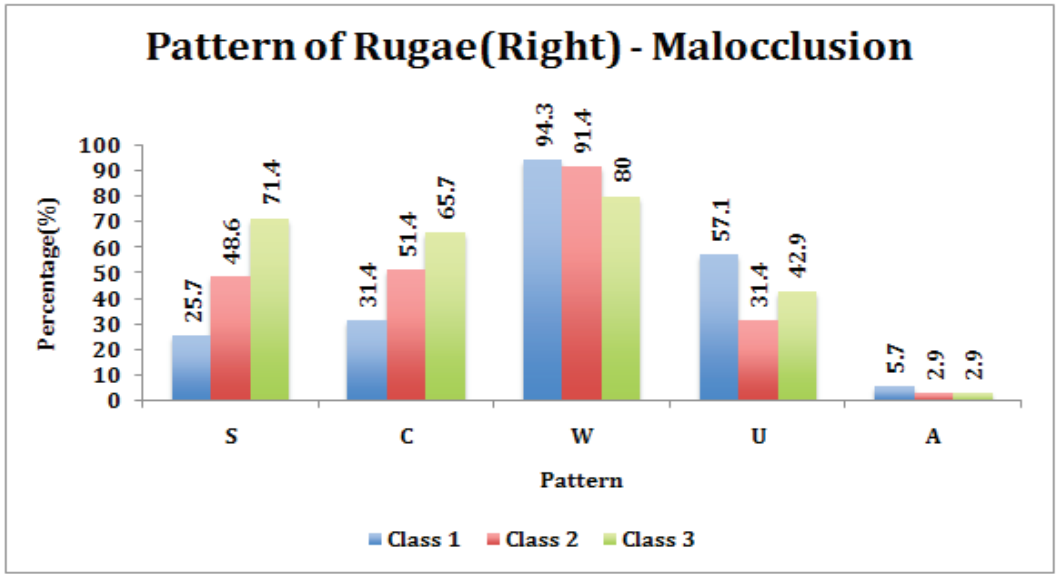

Figure 1: Graph showing the pattern of rugae on right side among the groups.

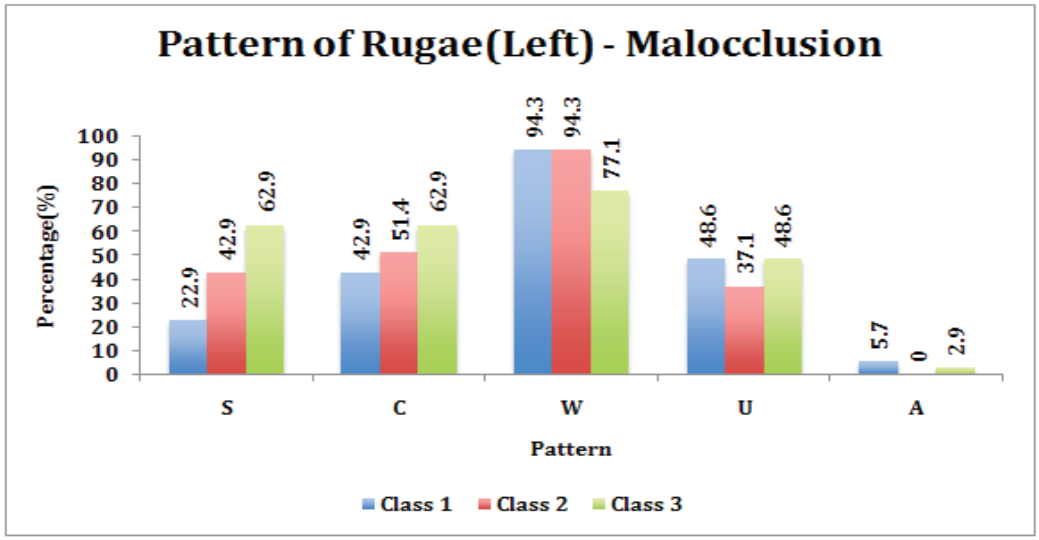

Figure 2: Graph showing the pattern of rugae on left side between the groups

Fischer's exact test compared the direction of rugae among the groups. Direction in all groups was horizontal (54.3% Class I, 85.7% Class II, 68.6% Class III).Irregularly directed rugae were seen highest in Skeletal Class I group(40.0%) as compared to the other groups and this was statistically significant (p value 0.003). (Figure 3).

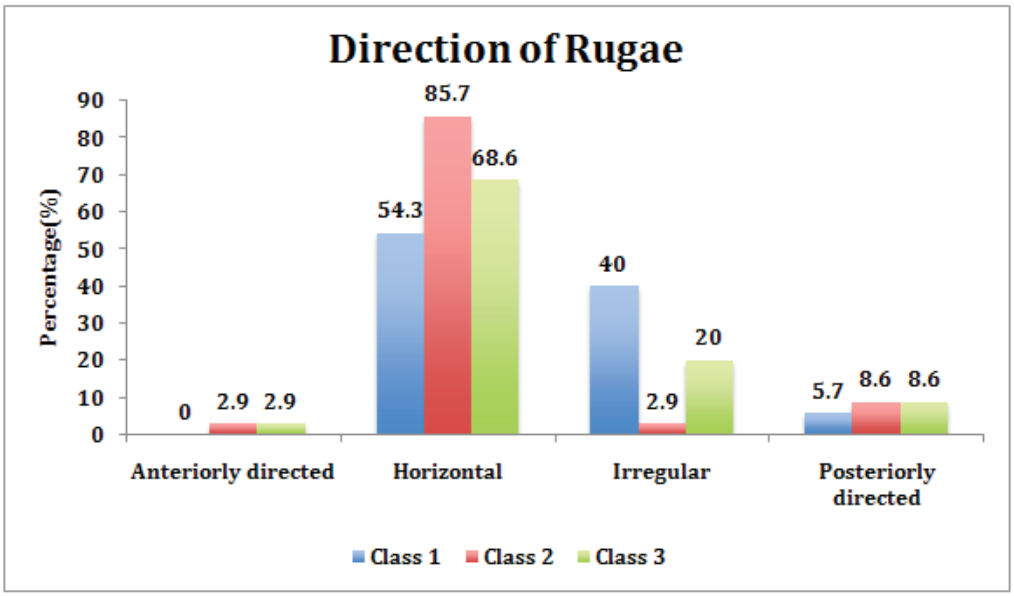

Figure 3: Fisher's Exact Test showing the direction of rugae alignment in different skeletal malocclusions among the groups

Droplet-shaped incisive papilla was identified to be predominant among different skeletal malocclusion groups. (Table 2).

Table 2:-

Shape of incisal papilla	Malocclusion			Total
	Class 1	Class 2	Class 3	
Cylindrical	11	7	8	26
	31.4%	20.0%	22.9%	24.8%
Droplet	24	28	27	79
	68.6%	80.0%	77.1%	75.2%
Total	35	35	35	105
	100.0%	100.0%	100.0%	100.0%
Chi square test	Chi square value = 1.33(2), p-value =0.52(NS)			

*p<0.05 statistically significant, p>0.05 Non significant, NS

Table 2: Chi Square Test showing the shape of the incisive papilla among the groups

Discussion

Palatal rugae with their individual uniqueness have aided in forensic identification and population identification and have imposed their importance in cases were digit biometrics are unavailable. The shape of the palatal rugae seems to remain constant throughout life.[12]Palatal rugae facilitate population identification as they possess identical characteristics amongst certain racial groups.[13]Like fingerprints the palatal rugae do not alter during the course of life with only increase in length due to normal growth.[14]

Even though examination of the palatal rugae is relatively a subjective process, it can be easily recorded sans any complex armamentarium. Palatal rugae are unique in each individual similarly, in this present study, each subject's palatal rugae were found to be unique.[15-18]

Some authors suggest that palatal rugae remain unchanged as of 12th weeks of intrauterine life; whereas other authors suggest that palatal rugae may change quantitatively with increasing age but retain their general configuration.[19, 20]

In the present study we only assessed the number and shape of the palatal rugae among different skeletal malocclusion groups and no time related evaluation of the rugae was undertaken.

The number of PPR ranged from 2-6 and SPR ranged from 0-5 in the subjects examined in the present study. Study done by Surekha et al[5] showed more number of PPR in Kerala population as compared with Manipuri population. In addition, there was significant difference among different Sagittal Skeletal Malocclusion groups in terms of the overall number of PPR on either sides of the palate. Primary rugae were distributed more on the right side of the palate among the groups, especially in Skeletal Class II and Skeletal Class III. These results concur with those of Kallianpur et al [21]who compared rugae patterns of Indian and Nepalese population. Rugae were higher in number on the right side of the palate in Indians as compared to Nepalese population but the results were not statistically significant. Dhoke and Osato[22] and Kapali et al [13], explained the phenomenon of regressive evolution that dominates the right side of the palate mainly pertaining to secondary rugae. Our results may thus vary due to the exclusion of secondary rugae and based on the population chosen.

According to Thomas 1983, palatal rugae do not undergo any changes except in length, throughout a person's life probably due to underlying growth.[11]Comparative studies performed amongst geographically diverse populations belonging to Indian regions such as Karnataka and Kerala[23] and Manipur and Kerala[5], have demonstrated important differences in rugae pattern. A study comparing two groups of Indian population (southern Indians and western Indians) predominantly showed the prevalence of wavy and curved rugae forms followed by straight rugae pattern.[24]Studies conducted by Nayak et al[25],Kotrashetti el al[26], Kumar el al[27],Surekha et al[5],Shanmugam et al[7], Bajracharya et al[28] and Kapali et al[13]showed the predominance of curved and wavy pattern of rugae in most populations. The Present study was aimed more towards assessing the characteristics of rugae in various skeletal malocclusions in Kerala population. Wavy pattern was seen most predominantly on both sides in Class I followed by Class II and Class III skeletal malocclusion. These are in accordance with the results published by Surekha et al[5] and M Selvamani et al[29] and SwethaS[30]. This was followed by curved, straight and unification pattern of rugae. Study by J K Savitha et al[23] has seen similar results where curved rugae were more prominent in Kerala population as compared to Karnataka population. Horizontal rugae alignment and droplet-shaped incisive papilla was identified among all three skeletal dysplasia groups.The study by Ekrem Oral et al[10] also reported droplet-shaped incisive papilla to be the most common type in Turkish population. M Selvamani et al [29]concluded that females of Kerala origin had more number of primary rugae as compared to males. In our study we have not compared for sexual dimorphism among the various skeletal malocclusion. This leaves room for future scope of the study.

Further studies on a large number of subjects of varying Indian ethnicities are required in order to confirm the relationship between the pattern of palatal rugae and sagittal skeletal malocclusion.

Conclusions

- Primary rugae were significantly distributed more on the right side in comparison to the left side on the palate, especially in skeletal Class II and Class III.
- Wavy and curved pattern of the rugae were seen on both right and left side of all the skeletal malocclusion groups and skeletal Class III had more number of straight rugae.
- Direction of rugae alignment was horizontal and droplet-shaped incisive papilla was identified among different skeletal dysplasia groups.
- Palatal ruage may serve as valuable indicators for population identification and help in facial reconstructions through their association with varying skeletal malocclusions.

Ethical Clearance: Ethical clearance was obtained from the 'Ethics Committee' of the Institution prior to the start of the study.

Source of Funding: Self

Conflict of Interest: Nil

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