

Anthropometric analysis of palatal rugae pattern, face form and arch form among Indian population at Moradabad, India

Meenakshi Bisht^{1,*}, Pragati Rawat², Ravi Madan³, Siddhi Tripathi⁴

^{1,2}PG Student, ^{3,4}Reader, Department of Prosthodontics and Crown & Bridge, Kothiwal Dental College and Research Centre, Moradabad, Uttar Pradesh, India

***Corresponding Author:**

Email: drmeenakshibisht@gmail.com

Abstract

Purpose: To evaluate the correlation between the palatal rugae pattern, face form and arch form among Indian population at Moradabad, India.

Materials and Methods: Alginate impressions of maxillary arch was made and cast was poured immediately with type III dental stone. A sharp graphite pencil was used for marking outline of the rugae on the cast. A digital caliper was employed for measurement of length of palatal rugae. Palatal rugae were analysed in accordance with Thomas and Kotze classification. Arch form of these models was determined with using 3M Unite template. For assessment of the face form, the subjects were seated in an upright position on the operator chair and the camera was stabilized on a tripod. Then photographs of the frontal profile were taken. These photographs were used for the analysis of the face form. The data was subjected to one way analysis of variance test and Post Hoc test.

Results: The average number of primary rugae (10.76%) were found to be more predominant than secondary (2.12%) and fragmentary rugae (1.54%). The most predominant shape of palatal rugae were curved (42.19%) followed by wavy (32.71%), straight (17.37%) and circular (0.92%). Based on the direction of the rugae, forward rugae (54.27%) were found more common followed by backward rugae (37.26%) and perpendicular rugae (0.55%). Base on the unification of rugae pattern, diverging rugae (4.55%) were found to be more common than the converging rugae (1.57%). The most common face form was ovoid (72.4) % followed by tapered (24.4%) and square (3.2%). The most prevalent arch form was ovoid (62.2%) seen followed by the tapered (26.0%) and square (4.8%) arch form.

It was found that there was significant correlation between the face form and arch form among the study subjects ($p < 0.001$). However, no correlation was found between the rugae pattern, face form and arch form ($p > 0.05$). In term of arch form and face form, ovoid was the most common followed by tapered and square.

Conclusion: Within the limitations of this study, it was concluded that there was significant correlation between the face form and arch form among the study subjects. However, no correlation was found between the rugae pattern with face form and arch form.

Keywords: Rugae pattern, Arch form, face form, 3M template, Caliper.

Introduction

The science of anthropometry has been utilized in diverse fields including anatomy, paleoanthropometry, forensic sciences, cancer research, and cosmetic surgery.¹⁻³ Different studies on dental anthropometry have utilized arch length, facial height and rugae patterns as individual parameters.^{4,5} Palatoscopy is the study of palatal rugae, also called plicae palatinae transversae and rugae palatina, which are transverse ridges on the anterior part of the palatal mucosa, each side of median palatal raphe and behind the incisive papilla.⁶ These rugae are well protected by the lips, buccal pad of fat and teeth and survive post mortem insults. Hence they have been used in medico legal and forensic identification process. This study was formulated to evaluate and correlate the rugae pattern, face form and arch form amongst Indian population in Moradabad, India. The null hypothesis of the present study is that there is no correlation present between the rugae pattern, face form and arch form amongst Indian population in Moradabad.

Materials and Methods

A total number of 250 subjects, resident of Moradabad were selected from Outpatient Department (OPD) of Kothiwal Dental College and Research Centre, Moradabad. The materials used for the study were: Irreversible hydrocolloid –Alginate, dental stone, gluteraldehyde, distilled water. All the subjects between the age group of 18-25 years having full complement of teeth and correctly aligned dental arch were included in the study. Subjects who had undergone orthognathic surgery, orthodontic treatment, having allergy to impression material, congenital malformation, any bony or soft tissue protuberance, deformity or scars, trauma, asymmetry or cleft of the palate, severe malocclusion, crowding, spacing, missing or malaligned teeth, attrition, fracture, ectopic eruption and those wearing removable or fixed partial dentures were excluded from the study. Informed consent was taken from the chosen subjects after explaining the contents of the study to them. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) version 15.0 statistical analysis software. The values were represented in number (%) and Mean \pm SD.

Evaluation of Face form: The subjects were seated in an upright position on a chair. They were instructed to keep their head straight while an indigenously designed and mounted framework was positioned around their head and face. Then, the photograph of their face alongside the indigenously designed and mounted framework was taken with the camera Nikon cool pixel 810 (12.2 mega pixel with 26x zoom, sony HD- 720 lens) The lens of the camera was stabilized over a tripod stand. The photographs were used for the analysis of the face form as square, tapering & ovoid using following landmarks: 1) Forehead (two third up from the eyebrow line); 2) Middle of the face; 3) The

angle of the jaw. For the subjects with square face form, the widths across the forehead (two third up from the eyebrow line), and through the middle of the face (i.e. running from 2.5 cm in front of the tragus of the ear) and at the angle of the jaws, were equal. For the subjects with tapering face form, the widths across the forehead (two-third up from the eyebrow line) was greatest. The width through the midline of the face was less and at the angle of the jaw it was least. For the subjects with ovoid face form, the width through the middle of the face was greater than the width across the forehead or at the angle of the jaw. (Fig. 1)



Fig. 1: Photograph of the face alongside the indigenously designed and mounted framework (Ovoid, Tapered, Square)

Evaluation of Rugae Pattern: The rugae, seen as an elevated structure in the anterior part of the palate on the casts, were marked using sharp graphite pencil under adequate light illumination and magnification glass. The length of each rugae was measured using an electronic digital caliper (Fig. 2) and were accordingly grouped into three categories: 1) Primary: > 5 mm 2) Secondary: 3-5 mm 3) Fragmentary: 2-3 mm. The primary rugae pattern was sub-classified based on their shape, direction and unification. The rugae patterns were divided into 4 types based on the shapes as: Curved (a crescent shape and curved gently), Wavy (a slight curve at the origin or termination of a curved rugae), Straight (run directly from their origin to termination) circular (form a definite continuous ring).

Evaluation of Arch Form: Arch forms were determined using 3M unitek templates. A total of three templates with each template having one arch form (square, tapered or ovoid) drawn on it was used. The cast were placed over each template and checked for its arch form. The arch form was determined on the basis that all the teeth on the cast lay within the outline of the arch form drawn on the template. (Fig. 3)

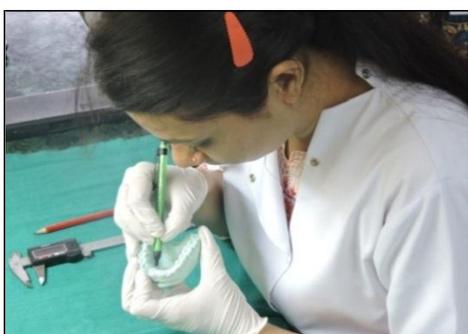


Figure 2: Marking the rugae pattern with graphite pencil on the cast

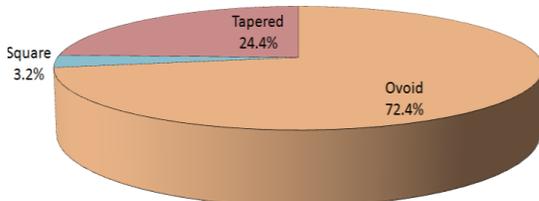


Fig. 3: Determination of arch form using 3M unitek template

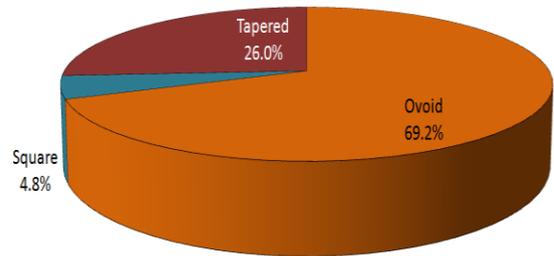
Results

The average number of primary rugae (10.76%) were found to be more predominant than secondary (2.12%) and fragmentary rugae (1.54%). The most predominant shape of palatal rugae were curved (42.19%) followed by wavy (32.71%), straight (17.37%) and circular (0.92%). Based on the direction

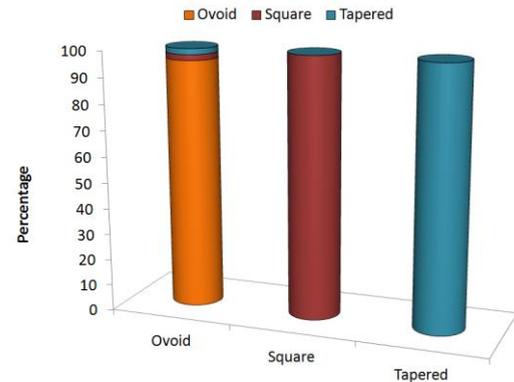
of the rugae, forward rugae (54.27%) were found more common followed by backward rugae (37.26%) and perpendicular rugae (0.55%) base on the unification of rugae pattern, diverging rugae (4.55%) were found to be more common than the converging rugae (1.57%). The most common face form was ovoid (72.4%) followed by tapered (24.4%) and square (3.2%) (Graph 1). The most prevalent arch form was ovoid (62.2%) seen followed by the tapered (26.0%) and square (4.8%) arch form (Graph 2). It was found that there was significant correlation between the face form and arch form among the study subjects ($p < 0.001$) (Graph 3). However, no correlation was found between the rugae pattern, face form and arch form ($p > 0.05$). In term of arch form and face form, ovoid was the most common followed by tapered and square (Table 1-3).



Graph 1: Percentage of facial form



Graph 2: Percentage of arch form



Graph 3: Association between facial form and arch form

Table 1: Face form and mean frequency of different rugae pattern (Overall)

Pattern	Ovoid (n=181)		Square (n=8)		Tapered (n=61)		Statistical significance	
	Mean	SD	Mean	SD	Mean	SD	F	P
Primary	10.79	2.67	10.88	0.99	10.67	2.10	0.058	0.943
Secondary	2.18	1.94	1.00	1.07	2.08	2.00	1.445	0.238
Fragmentary	1.61	2.18	0.25	0.46	1.49	2.02	1.595	0.205
Straight	1.82	1.62	2.38	1.69	1.97	1.73	0.577	0.562
Circular	0.08	0.42	0.38	1.06	0.13	0.59	1.454	0.236
Curved	4.52	2.21	3.38	1.60	4.74	1.95	1.467	0.233
Wavy	3.55	1.73	4.50	2.07	3.33	1.90	1.585	0.207
Forward	5.82	2.13	6.13	0.64	5.72	2.27	0.329	0.720
Backward	4.01	2.94	4.63	1.06	3.93	1.83	0.741	0.478
Perpendicular	0.06	0.47	0.00	0.00	0.05	0.28	0.088	0.916
Converging	0.17	0.41	0.25	0.46	0.20	0.40	0.331	0.719
Diverging	0.49	0.73	0.00	0.00	0.39	0.74	2.874	0.058

Table 2: Arch form and mean frequency of different rugae pattern (Overall)

Pattern	Ovoid (n=173)		Square (n=12)		Tapered (n=65)		Statistical significance	
	Mean	SD	Mean	SD	Mean	SD	F	p
Primary	10.88	2.67	10.25	1.60	10.54	2.14	0.717	0.489
Secondary	2.16	1.96	1.58	1.44	2.11	1.98	0.499	0.608
Fragmentary	1.63	2.21	0.75	1.48	1.43	1.98	1.075	0.343
Straight	1.79	1.59	2.42	1.62	1.98	1.77	1.022	0.361
Circular	0.09	0.43	0.25	0.87	0.12	0.57	0.671	0.512
Curved	4.58	2.21	3.25	1.48	4.65	1.97	2.333	0.099
Wavy	3.60	1.72	3.92	1.98	3.26	1.91	1.131	0.324
Forward	5.83	2.14	5.58	1.38	5.66	2.26	0.012	0.988
Backward	4.01	1.93	4.33	1.67	3.86	1.84	0.375	0.687

Perpendicular	0.06	0.48	0.00	0.00	0.05	0.28	0.147	0.863
Converging	0.16	0.41	0.17	0.39	0.20	0.40	0.206	0.814
Diverging	0.53	0.74	0.25	0.45	0.42	0.73	1.295	0.276

Table 3: Association between facial form and arch form

Arch Form	Face Form						Total	
	Ovoid		Square		Tapered			
	No.	%	No.	%	No.	%	No.	%
Ovoid	173	95.6	0	0	0	0	173	69.2
Square	4	2.21	8	100	0	0	12	4.8
Tapered	4	2.21	0	0	61	100	65	26
Total	181	100	8	100	61	100	250	100

$\chi^2=392.414$ (df=4); $p<0.0s01$

Discussion

Facial anthropometric studies have shown to have vast implications in health-related fields and are useful for prosthodontics, orthodontists, plastic surgeons, maxillofacial surgeons for their treatment plans, as well for physical anthropologists and forensic facial reconstruction experts.¹ In recent years, anthropometric study has become increasingly important in health assessment across many countries. It has ancillary importance in the determination of age, gender and race of an individual as applied in anthropology, archaeology, anatomy as well as in the forensic sciences.

The present study has been conducted to assess the anthropometric analysis of palatal rugae, face form and arch form amongst Indian population at Moradabad, India. Based on the results of the study, the null hypothesis of the present study that there is no correlation present between the rugae pattern, face form and arch form amongst Indian population in Moradabad was partly rejected. A significant correlation was found between the face form and arch form among the study subjects. However, no correlation was found between the rugae pattern with face form and arch form.

According to the results of the study, average number of rugae were found to be higher on the left side (7.22) as compared to right side (6.99). However the difference was not statistically significant. These results were in accordance with the results of the study conducted by Dohke and Osato⁷ who reported more number of rugae on the left side of the palate in comparison to the right side of the palate in Japanese population.

The average number of primary rugae (10.76%) were found to be more predominant than secondary (2.12%) and fragmentary rugae (1.54%). These results were in accordance with previous study conducted by Ahmed and Hamid⁸ who found out that primary rugae were more predominant followed by secondary and fragmentary.

Based on the shape of individual rugae, the results of the present study showed that the most predominant shape of palatal rugae was curved (42.19%), followed

by wavy (32.71%), straight (17.37%) and circular (0.92%). These results were in accordance with the results of the studies conducted by Asdulloh et al.⁹ and Kapali et al.¹⁰ It has been reported by Asdulloh et al.⁹ that curved rugae (32.12%) were most commonly seen followed by the wavy type (28.73%) and straight type (23.98%) in Lucknow, India. Kapali et al.¹⁰ had found that the most common shape of rugae were wavy and curved whereas straight and circular types were the least common in Australian Aborigines and Caucasians ethnic groups. However, few studies had contradictory results. Sumith et al.¹¹ reported that wavy pattern was the most predominant pattern among Pondicherry population followed by straight, curved and circular pattern. Paliwal et al.¹² concluded that wavy pattern was predominant followed by straight and curved in the Madhya Pradesh population, whereas wavy was followed by curved and straight in the Kerala population.

The results of the present study showed that the most common face form was ovoid (72.4%), followed by tapered (24.4%) and square (3.2%). These results were in accordance with the study conducted by Ibrahimagi et al.¹³ who found out that 83.3% had ovoid face form, 9.2% individuals had square-tapered face form and 7% individuals had tapered form in the population of Zenica, Bosnia and Herzegovina. However, few studies had contradictory results. Habib et al.¹⁴ reported that 49.65% of individuals had square tapering, 27.66 % individuals had square, 15.8% individuals had ovoid and 6.93% individuals had tapering face form in a Saudi population. Farias et al.¹⁵ reported that tapered face form accounted for 30% of subjects, with the oval shape accounting for 40% and square 0% (P=0.28) in Brazilian population. Also, Silva et al.¹⁶ reported that the most common face form according to his study was square (67.09%), followed by ovoid (18.99%) and triangular (13.92%) in Brazil population (P<0.001).

The most prevalent arch form according to the present study was ovoid (69.2%) followed by tapered (26.0%) and square (4.8%). These results were in accordance with the results of the studies conducted by Khatri et al.,¹⁷ Shafique et al.,¹⁸ and Othman et al.¹⁹

Khatri et al.¹⁷ reported that most common arch form was ovoid (50%) followed by tapered (32.5%) and square (17.5%) in Aurangabad population. Shafique et al.¹⁸ reported that most prevalent arch form was ovoid (87%) followed by tapered (5.3) and square (0%) in Lahore population (P<0.05). Othman et al.¹⁹ concluded that the most common arch form was ovoid followed by tapered and square in Malaysian population. However, few studies had contradictory results. Tajik et al.²⁰ reported that most common arch form was tapered (41.8%), followed by ovoid (32.7 %) and square (25.4%) in Peshawar population (P=0.749). Nojima et al.²¹ found out that tapered (44%) arch form was most common followed by ovoid (38%) and square (18%) in American Caucasian population whereas in the Japanese population the square arch form (46 %) was most common followed by followed by ovoid (42%) and tapered (12%).

In the present study it was seen that a statistically significant correlation existed between face form and arch form (p<0.001). This was similar to the studies conducted by Nayar et al.²² and Sellen et al.²³ However, no correlation was found among rugae pattern with the face form and arch form.

Comparison with other geographical population would provide better understanding of population variation. It is recommended that further studies be conducted which should take into account the reliability and validity of various arch form determining methods, so that a gold standard may be established.

Conclusion

Within the limitations of this study, it was concluded that there was significant correlation between the face form and arch form among the study subjects. However, no correlation was found between the rugae pattern with face form and arch form.

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