An In Vitro Study to Check Role of Palatine Rugae in Maxillary Canine Positioning As Well As in Gender Identification

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Abstract: *Palatine rugae are the characteristic soft tissue folds on the anterior third of the palate. These are highly individual and consistent in shape throughout life. Palatine rugae are important as it can be useful in many ways. When identification of an individual by other methods as finger print ,lip print etc is inconclusive, palatal rugae may be considered as an alternative source of information (usually if comparative material is available) enabling the search field to be narrowed. Palatal rugae pattern in different ethnic groups may differ. This also can be used to narrow down the search.*

Preserving natural appearance in edentulous patients is a challenge. This can be done by proper teeth arrangement as per the natural positioning of the teeth. Palatine rugae can be used as a potential reference to determine canine and other teeth position, which in turn will be useful for teeth arrangement in complete denture. So the study was carried out to determine the role of palatine rugae in maxillary canine positioning as well as for gender identification.

Keywords:*Palatine rugae, human identification, maxillary canine, teeth arrangement.*

I. Introduction

Palatine rugae or Transverse palatine folds are irregular fibrous connective tissue ridges located in the anterior third of the hard palate [1]. These rugae are arranged in transverse direction from the mid-palatal raphe located in mid-sagittal plane [2].Winslow was the first to describe palatine rugae in 1732, and the earliest illustration was given by Santorini in 1775 [3,4,5].The rugae pattern orientation is formed by about 12^{th}to14^{th} week of prenatal life and remains stable until the oral mucosa degenerates after death [6].Palatoscopy is study of palate while rugoscopy is the study of the patterns of grooves and ridges (rugae) of the palate [3].

Morphological characteristics of Rugae are stable over time, except in length, due to normal growth, remaining in the same position throughout a person's life [3-10].At the same time anatomical position of the rugae is such that they are protected inside the mouth by cheeks, lips, tongue, teeth, bone and buccal pad of fat from trauma and high temperature. So they can be used in the same way as fingerprints for human identification. When identification of an individual by other methods as finger print, lip print etc. is inconclusive, palatal rugae may thus be considered as an alternative source of information enabling the search field to be narrowed [3,4,6,7.]According to some researchers, palatine rugae can be used for gender identification.

Preserving a natural appearance is the most important part of treatment of every edentulous patient. One of the important factors in producing natural appearance in edentulous patient is tooth position. Proper placement of teeth should be functional as well as esthetically pleasing [11]. Many anatomical landmarks can be used to decide the position of artificial teeth and called as biometric guide. The incisive papilla decides the placement of central incisors, canine eminence decides the placement of canine, and the maxillary tuberosity decides the position of last molar in the maxillary arch. Similarly, Palatine rugae can be a reliable landmark in teeth arrangement particularly canine or premolar positioning.

So the present study was carried out to find out role of palatine rugae in gender identification and teeth positioning during artificial teeth arrangement.

II. Aim and Objectives

Aim of the study was to evaluate role of palatine rugae in gender identification, ethnic differentiation and maxillary canine positioning.

III. Objectives

1. To determine the palatine rugae pattern in males.
2. To determine the palatine rugae pattern in females.
3. To compare palatine rugae patterns among male and female.
4. To determine the relation between palatine rugae and maxillary teeth positioning.
5. To compare palatine rugae patterns among two ethnic groups –Maharashtrian and Gujarati.

IV. Materials And Methods

The sample of 100 students, of which 50 were Maharashtrians and 50 were Gujarati, was taken. With the help of perforated metal stock tray, Alginate (Marieflex, Septodent Healthcare India Pvt.Ltd, Panvel, India) impression of Maxillary arch was made for all subjects .The impressions were sterilized with 2% glutaraldehyde. Then impressions were poured into with Type IVdental stone (Kalabhai product).

Cast Analysis:A markingpencilwas used to highlight the rugae without causing any damage. Rugae were then transferred on a tracing paper. All the quantitative measurements were calculated using electronic digital caliper. The measurements were recorded. Similar procedure was followed for all the subjects.

In this study, the rugae patterns were recorded considering the classification given by Thomas et al in 1983. As per this classification, length of the rugae were classified into as primary >5mm, secondary3-5mm, fragmentary <3mm and Shape into curved, wavy, straight and circular.

Also**,** the relationship of rugae to canine was studied.On the maxillary cast a line [Line A] was marked along center of incisive papilla and mid-palatine raphe. Another line [Line B] was marked perpendicular from the midsagittal line to the end of the 1st palatine ruga and was extended to the associated maxillary tooth. (Figure 1)

Figure 1: Relation between 1st Palatine rugae and Maxillary Canine Position.

V. Statistical analysis

The size, shape and position of rugae pattern were studiedand Bar and pie charts were used to depict the distribution of the various patterns. Chi-square analysis was used to compare the proportionality differences in distribution of the patterns in the ethnic groups and the associations between the distributions of the different rugae size, shape and position. P-Value ≤0.05 is considered as being statistically significant.

VI. Results

Shape analysis:

The shapeand size of palatine rugae wereanalyzed. In males as well as in females the most prevalent shapewas wavy followed by curved. Rugae pattern was not symmetrical either in number or itsdistribution when the right and left sides were compared. In males, on right side, 52% rugae were wavy, 30 % curved, 12 % straight, 6 % circular. While on left side 58% were wavy, 32% curved & 10% straight. In females, on right side 48% were wavy, 30 % curved, 18 % straight & 4% were circular. Left sideshowed 58 % wavy, 30% curved&12 % straight palatine rugae. Chi-square analysis of the pattern of distribution on the sides showed insignificant association in the pattern of distribution of the various shape (p=0.2146 on right side & p=0.7194 on left side).The details of gender wise distribution of palatine rugae shape pattern are in graph 1.

Size analysis:

According to size, Primary rugae were more prevalent in males than infemales. In males, 74 % rugae were primary while in females only 52 % rugae were primary. But still Chi square analysis test revealed insignificant difference between rugae size and sex on both sides (p=0.075). The details of gender wise distribution of palatine rugae size pattern are in graph 2.
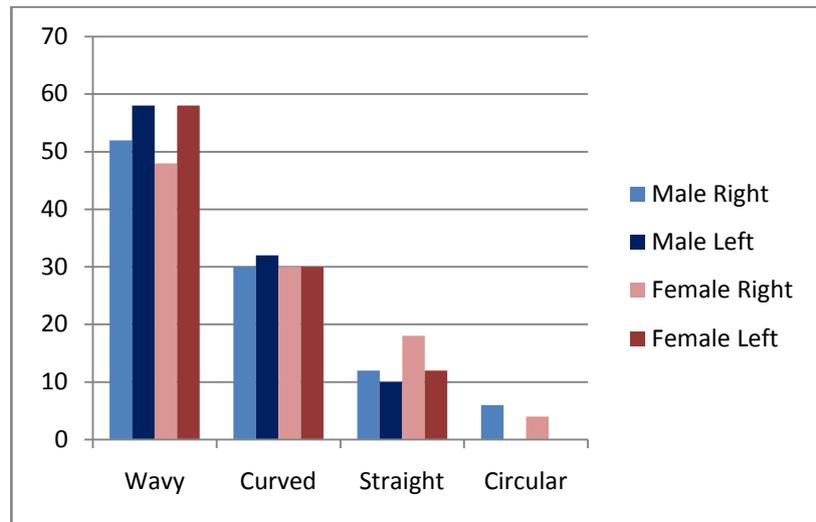
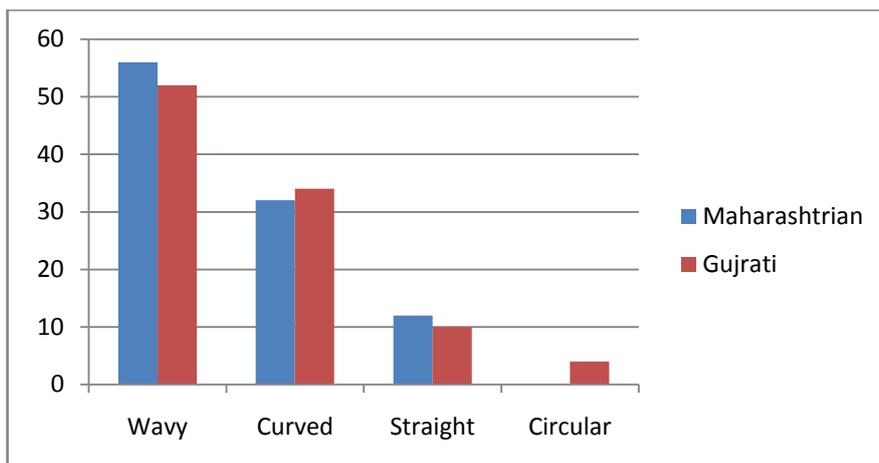**Graph 1:**Shape Analysis as per the Gender
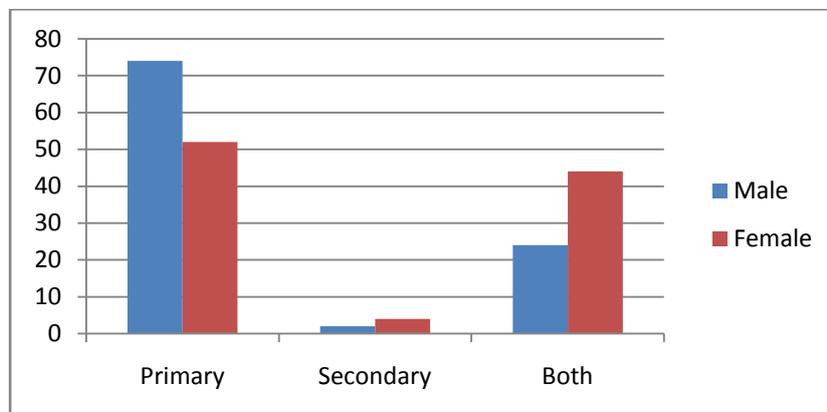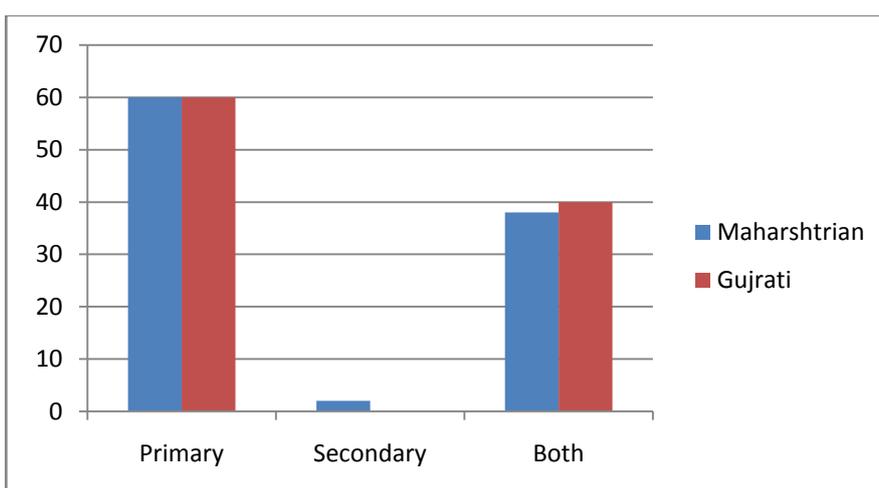

Graph 2: Size Analysis as per the Gender

Ethnic group:
The size and shape of rugae pattern is compared between Maharashtrian and Guajarati groups. According to shape, In Maharashtrian group, 60% rugae were wavy, 32 % were curved, and 12% werestraight. While in Guajarati group, 52% were wavy, 34 % curved and 14 % were straight. Chi-square analysis of the pattern of distribution showed insignificant association in the distribution pattern of various shape among the ethnic group (p=0.6656).

According to size, In Maharashtrian group 60 % subjects had primary rugae and 2% had secondary rugae while remaining 38 % subjects had both primary as well as secondary rugae. Almost similar results were observed in Gujarati group too. 60% subjects had primary rugae ,40 % had both types of rugae and 0% had secondary rugae.The details of shape and size distribution of palatine rugae depending upon ethnicity are described in graph 3 and graph 4 respectively.

Graph 3: Shape Analysis as per the Ethnicity

Graph 4: Size Analysis as per the Ethnicity

Position analysis:

In this study the position of first palatine ruga with canine position were recorded. Maxillary Canine was divided in 3 parts- mesial 3rd, middle 3rd and distal 3rd. In 30 % males, 1strugawas in line with mesial side of canine, in 60% male subjects, it was in association with middle of canine and only in 10% males the 1st palatine ruga was related to distal $1/3^{rd}$ of canine. But in females it was observed that in 58 % female subjects, 1strugawas in line with mesial side of canine; while in 42% female subjects, it was in association with middle of canine. The 1st palatine ruga was not at all related to distal $1/3^{rd}$ of canine in females. This canine positioning distribution is shown in Graph 5.
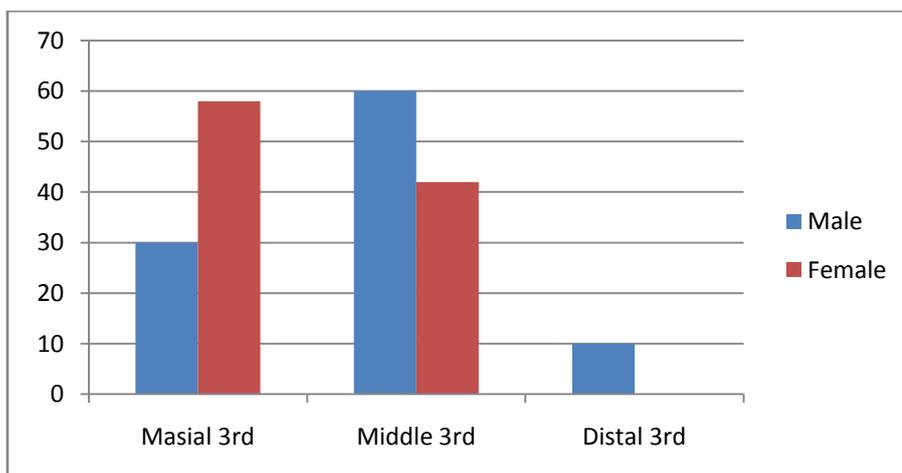
Graph 5: Relation between Canine position and palatine rugae in males and females

VII.   Discussion

Palatine rugae or also called Transverse palatine folds are asymmetrical and irregular elevations of the mucosa located in the anterior third of the palate. Palatoscopy or Rugoscopy is study of palatal rugae in order to establish a person's identity. Palatine rugae are important structures in many ways. They considered secondary stress bearing areas for maxillary denture. Many authors proposed their use not only for gender identification but also for personal identification. While some researchers considered them as useful anatomical landmark for canine or premolar positioning during maxillary teeth arrangement. It can be used in the same way as fingerprints. When identification of an individual by other methods as finger print, lip print etc. is inconclusive, palatal rugae may thus be considered as an alternative source of information (usually if comparative material is available) enabling the search field to be narrowed.

In present study, the rugae patterns were studied using the classification given by Thomas et all in 1983. This method was found to be practical and easy to perform and less time consuming. According to the study, the palatal rugae patterns of all 100 individuals were different from each other which meanstheyare highly individualistic. Hence palatine rugae can be considered for forensic identification but this is possible if comparative material is available.M Ohtani et al (2008) analysed the limitations of using palatal rugae for personalidentification in edentulous patients. In their study, although 90% of the 48 cases analysed, matched correctly but three misleading factors were found as (i) poor demarcation of palatal rugae (ii) noncomplex pattern of rugae (iii) changes in palatal height [13].Similar results were observed by Shriram C Bansode, Meena M Kulkarni in their study Importance of palatal rugae in individual identification. In their study they studied casts of 30 subjects and concluded that Palatal rugae patterns are unique to an individual, and can therefore be used for individual identification in forensic odontology[14].

Results of the present study showed that no statistical significant difference was present between rugae patterns of male and females. In both groups wavy shape of rugae were prominent followed by curved and straight.Comparison of rugae pattern on basis of size of the rugae showed that primary rugae were more prevalent in males than in female subjects. Though the difference was not significant this factor might be used for gender identification. So as per the results of the present study, reliability of palatine rugae for gender identification was questionable.The results of the present study were in accordance with that of many others where they concluded that there were no significant differences between the two sexes in palatine rugae pattern [6, 15] at the same time results were in contrast to those who concluded Palatal rugae patterns can aid in gender differentiation and race differentiation [16, 17].

When the palatine rugae pattern was compared in different ethnic groups such as Maharashtrian&Gujrati, it was observed that in both groups wavy palatine rugae were prevalent. Similarly in both groups, primary rugae were prevalent than secondary palatine rugae.Our study however did not record any statistical significant gender difference in shapes of rugae and length and also between ethnic groups (Marathi and Gujarati). This study agrees with the study done by Ibeachu P.C.et al.[18].

The present study showed co- relation between 1st palatine ruga and the maxillary canine position. The results showed that in males 1st palatine rugae was mainly associated with middle 3rd of canine (60%) while in females 1st palatine rugae prevalently in line with mesial 3rd of the canine (58%). This finding of the study is important and can be used while arranging maxillary teeth depending upon gender of the patient. Palatine rugae can beareliable anatomic landmark in the arrangement of anterior teeth. Therefore, it can be used as a guide for arranging teeth for complete denture.In a similar study ArunaBhandari et al marked a point at distal most part of last rugae. They observed that the point when extended laterally it was in line with distal part of 2nd premolar and it concluded that it can be considered as a stable landmark for positioning the maxillary premaolars[12] Grove H.F. and Christensen L.V. in their study relationship of the first palatine rugae to the maxillary canine in men observed that when a baseline was marked joining the distal contact points of maxillary canine, distance of the 1st palatine rugae were about 1mm anterior or posterior to the baseline [19].

VIII.   Conclusion

This study showed individualistic nature of palatal rugae. Every individual presented a distinct but unique pattern with no evidence of sexual dimorphism and also no difference in ethnic group. The study also demarcates importance of palatine rugae in maxillary canine positioning during teeth arrangement. So following conclusions can be made from the present study.

1. The present study showed individualistic nature of palatine rugae, so can be used for personal identification.

2. 1st palatine rugae can be considered as important anatomical landmark for maxillary canine positioning. In Males, 1st palatine rugae was in line with middle of the maxillary canine while in females it coincided with mesial part of maxillary canine.

3. The present study found no evidence about use of palatine rugae for gender identification.

4. As per the present study, palatine rugae pattern does not differentiate between ethnic groups.

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