Full Length Research Paper

Comparative analysis of variation in morphology of rugae pattern amongst sibling pairs

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Palatal rugae are epithelial ridges on anterior part of palatal mucosa on each side of mid palatine raphe behind incisive papilla. The aim of this study was to compare the uniqueness of rugae pattern amongst sibling pairs, determine the predominant rugae pattern and to assess the gender difference in rugae forms in 5 to 15 years old children and its utility in sex determination. Casts of 50 sibling pairs aged 5 to 15 years were obtained and the rugae pattern was analyzed using Santos's classification. The association of gender with the number of rugae pattern was tested using Chi-square test and unpaired t-test. A significant level of 5% was considered as critical value. All analysis was done using the Statistical Package of Social Sciences 17.0 software (SPSS Inc., Chicago, IL). Rugae were almost uniformly distributed among males and females. The rugae patterns were uniquely structured and there was no evidence of similarity amongst siblings. The most observed form of rugae was curve (30.89%) followed by line (21.07%) and sinous (19.62). Palatal rugae serve as a reference landmark in various dental treatment modalities and can be a valuable tool for personal identification. Rugae pattern may be an additional method of differentiation between the Indian male and female children.

Key words: Palatal rugae, palatoscopy, identification tool, forensic odontology.

INTRODUCTION

Palatal rugae are epithelial ridges on anterior part of palatal mucosa on each side of mid palatine raphe behind incisive papilla (Bajracharya et al., 2013). Anatomically, the rugae consist of oblique ridges that radiate out tangentially from the incisive papillae.

Histologically, the rugae are stratified squamous; mainly para keratinized epithelium on a connective tissue base, similar to the adjacent tissue of the palate (Gray, 2008). Embryologically, differences in the rugae cores from human embryo of over 20 weeks are observed (Datta,

2007). Owing to their anatomical position in oral cavity, these asymmetric ridges provide excellent post mortem details in human identification as they remain well protected from trauma and incarnation (Bajracharya et al., 2013).

The study of palatal rugae is called as Rugoscopy/Palatoscopy which was first proposed in 1932, by Spanish investigator Troban Hermas (Rajan et al., 2013). Presently, rugoscopy also encompasses various fields of dentistry including forensic odontology, prosthodontics and orthodontics. Palatal rugae are highly individualistic and distinctive and act as an adjunct to other methods of identification which mainly include dental record, finger prints and DNA comparisons (Shetty and Premalatha, 2011). Amongst these palatoscopy is a lesser known and unusual technique but is preferred sometime because of its low utilization cost, simplicity and reliability in forensic sciences (Rajan et al., 2013; Shetty and Premalatha, 2011).

This study was attempted with the following aims and objectives: to compare the uniqueness of rugae pattern amongst sibling pairs; to determine the predominant rugae pattern in 5 to 15 years Indian children; and to assess the gender difference of rugae forms in 5 to 15 years old children and its utility in sex determination.

MATERIALS AND METHODS

Fifty sibling pairs aged 5 to 15 years were randomly selected from outpatient Department of Paedodontics and Preventive Dentistry and designated as samples. The sample comprised of 50 males and 50 females. Only subjects who were healthy, free of congenital abnormalities, inflammation, trauma or orthodontic treatment were considered. Subsequent to the informed consent from subject's parents/guardian, maxillary arch impressions were made using addition silicone as impression material owing to its high tear strength and accuracy. The casts were then made by pouring type 3 dental stone in the impressions. Casts selected for the study were obtained from chosen subjects and were free of any air bubbles or voids, especially in the anterior one-third of the palate.

Rugae patterns on the cast were delineated using black graphite pencil under adequate light and were subsequently analyzed using Santos's classification (Caldas et al., 2007) which is a practical classification based on the rugae location. This classification indicates and characterizes the following: one initial rugae, the most anterior one on the right side is represented by a capital letter; several complementary rugae, the other right rugae are represented by numbers; one sub-initial rugae, the most anterior one on the left side is represented by a capital letter; several sub-complimentary rugae, the other left rugae are represented by numbers.

Rugae patterns (Figure 1) were recorded as per the classification and results were tabulated. The numbers and letters given to each rugae based on its form is as shown in Table 1 (Caldas et al., 2007).

Statistical analysis

The association of gender with the number of rugae and pattern was tested using Chi-square test. Association between rugae forms and gender were tested using unpaired t-test. A significance level of 5% was considered as critical value. All analyses were done using the Statistical Package of Social Sciences 17.0 software (SPSS Inc., Chicago, IL).

RESULTS

Total rugae recorded in 100 samples were 1447 which were almost uniformly distributed among males (727) and females (720) (Figure 2). The rugae patterns were uniquely structured and patterned in all the individuals and there was no evidence of similarity amongst siblings. Variable rugae patterns were observed in each working cast depicting that every individual has a different set of rugae pattern. However, the most observed form of rugae was curve (30.89%) followed by line (21.07%) and sinous (19.62). Point (0%) amongst all other rugae form was the most infrequently observed (Figure3).

Contrast in rugae pattern was noticed on comparing both sexes. Curve (29.57%) and sinuous (20.35%) forms were frequently seen in males, while in females curve (32.22%) and line (22.5%) forms were more common (Figure 4).

An uneven distribution was recorded on both sides. Wherein, the number of rugae observed on right side (761) was more than on left side (686). However, curve was the most repeated pattern seen on both the sides (Figure 5).

DISCUSSION

Rugae as defined by Glossary of Prosthodontic Terms-8 are anatomical folds or wrinkles (usually used in the plural sense); the irregular fibrous connective tissue located on the anterior third of the palate (The Academy of Prosthodontics, 2005). Palatal rugae also known as plicae palatinae transversae or rugae palatina as these are transversely running crests in mammals, which are exclusively formed by the mucosa of the hard palate except where an ossified base can be distinguished (Rajan et al., 2013; Saraf et al., 2011).

Every individual presents with unique and relatively permanent palatine rugae patterns as observed in this study. They remain reasonably stable during the patient's growth; thus, they may serve as suitable reference points from which the clinician can derive the reference planes necessary for longitudinal cast analysis (Rajan et al., 2013). Also, their fingerprint like uniqueness help to establish identity of an individual through discrimination (via casts, tracings or digitized rugae patterns) thus are considered as an alternative source of information in forensic (English et al., 1988; Saraf et al., 2011).

The inimitable property of palatal rugae to retain their shape throughout the life is derived from their structural element containing glycosaminoglycans which by its

Table 1. Matins dos santos' palatal rugae classification.

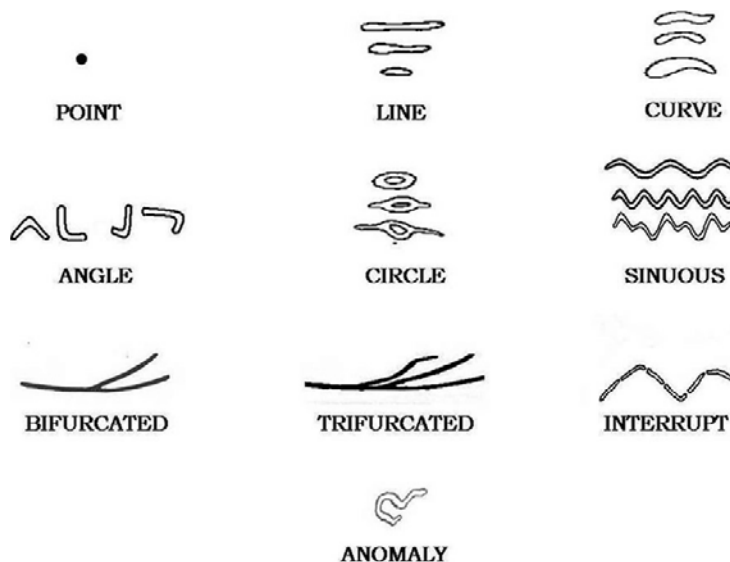| Rugae type	Anterior position	Other position
Point	P	0
Line	L	1
Curve	C	2
Angle	A	3
Circle	O	4
Sinuous	S	5
Bifurcated	B	6
Trifurcated	T	7
Interrupt	I	8
Anomaly	An	9

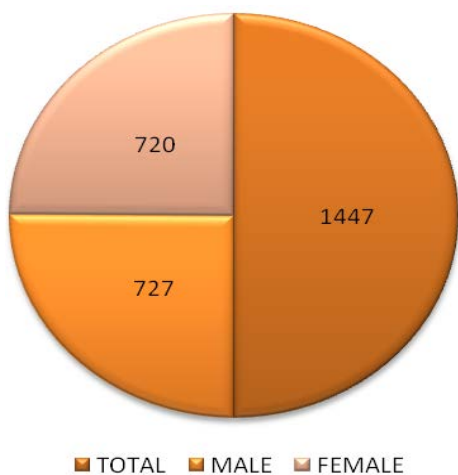**Figure 1.** Different forms of palatal rugae.

Figure 2. Distribution of rugae pattern amongst male and female.

hydrophilic nature causes the tissues to swell and contributes to the maintenance of the shape of rugae throughout life. Fibroblasts and collagen fibers beneath the thickened epithelium contribute to the stability of palatal rugae (Shetty and Premalatha, 2011).

This study was to determine the uniqueness of rugae pattern amongst sibling pairs, establish the predominant rugae pattern in 5 to 15 years Indian children and to assess the gender difference of rugae forms in 5 to 15 years old children and its utility in sex determination.

In the present study, the rugae patterns were uniquely structured and patterned in all the individuals and there was no evidence of similarity amongst siblings. Similar observations were recorded by Ibeachu et al. (2014) who compared rugae patterns amongst different ethnic groups of Nigeria. Comparable results were obtained by Virdi et al. (2009). Indira et al. (2011) also concluded that rugae pattern is unique for each individual suggesting heredity
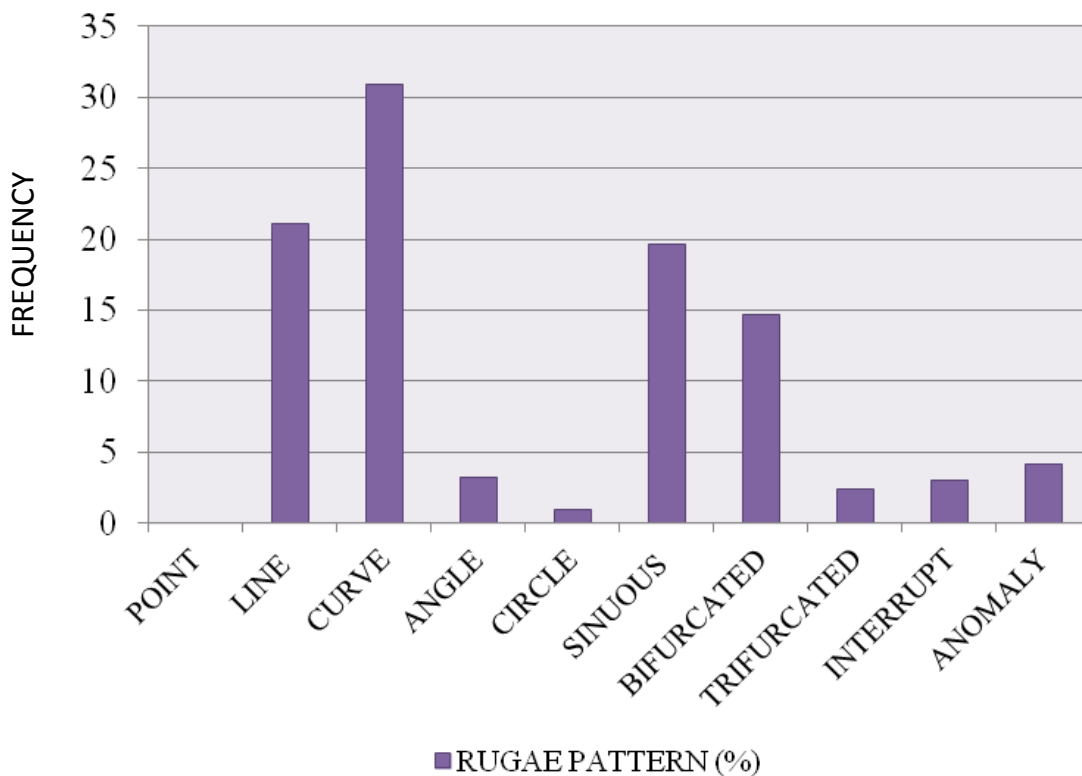
Figure 3. Representation of variation in the forms of palatal rugae pattern.
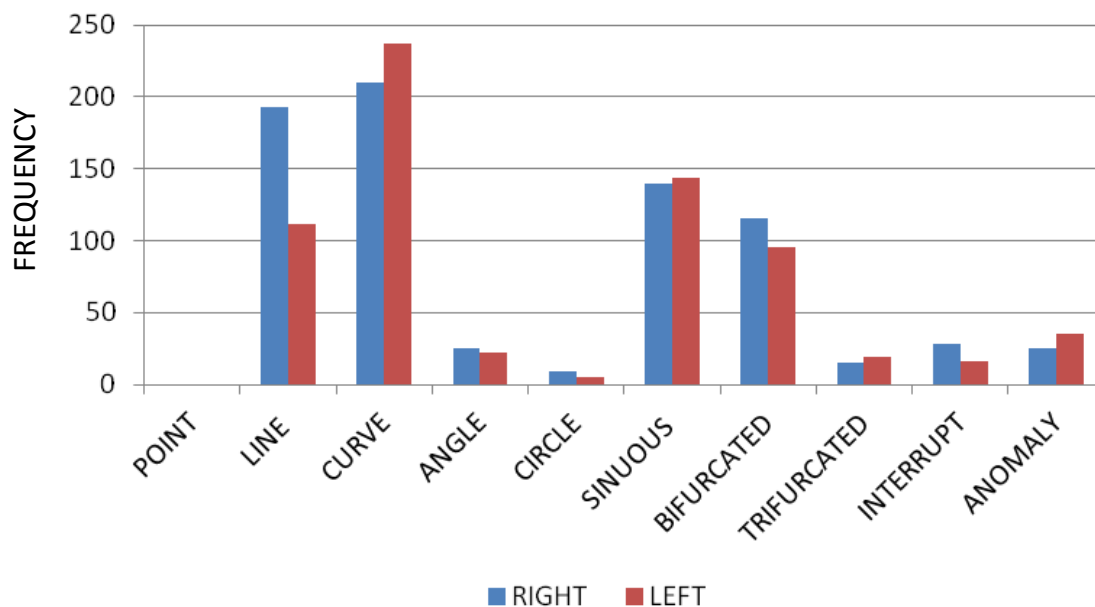

Figure 4. Variation in the distribution of different forms of rugae pattern on right and left side.

does not play an important role in determining the orientation of rugae pattern. This finding is in congruity with results obtained in the similar studies conducted earlier (English et al., 1988; Shetty et al., 2005).
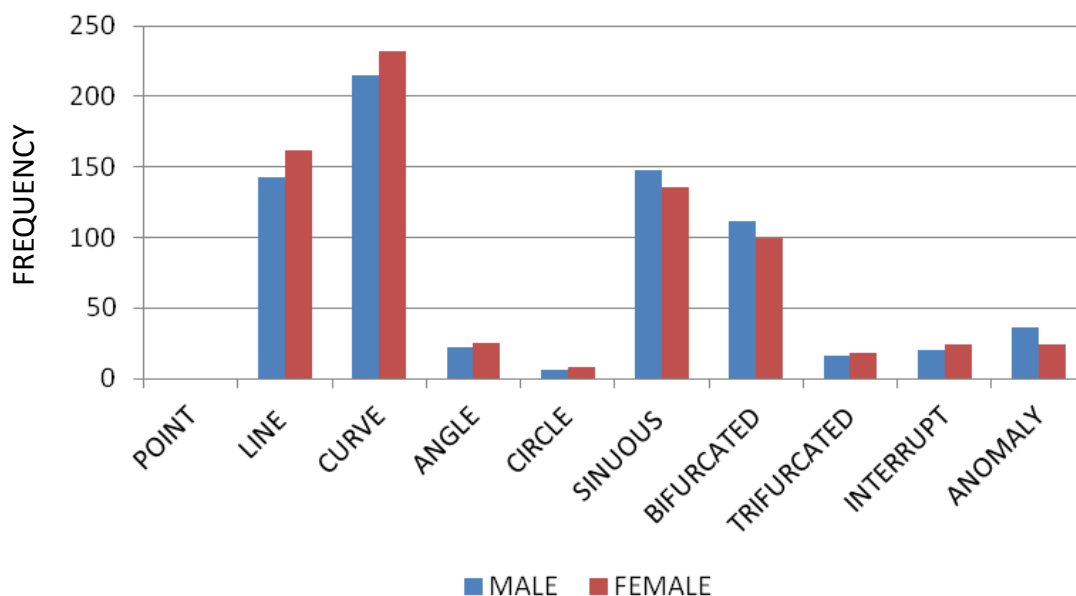
Figure 5. Variation in the distribution of different forms of rugae pattern among males and females.

The most observed form of rugae was curve (30.89%) followed by line (21.07%) and sinuous (19.62). Point (0%) amongst all other rugae forms was most infrequently observed. Contrast in rugae pattern was noticed on comparing both sexes. Curve (29.57%) and sinuous (20.35%) forms were frequently seen in males, while in females curve (32.22%) and line (22.5%) forms were more common.

Saraf et al. (2011) reported that wavy and curved pattern of rugae were found to be statistically different in the sexes, but were more common in both males and females. A significant gender difference was noticed in the circular type which was higher in males. Shubha et al. (2013) concluded that north Indian males have more number of rugae than their counterparts. Moreover, the percentage of curve rugae was more in north Indian.

Shetty et al. (2005) reported more number of curve form in Mysorean population and wavy form in Tibetan population. However, wavy form of rugae was predominant according to Rajan et al. (2013).

An uneven distribution was recorded on both sides. Wherein, the number of rugae observed on right side (761) was more than on left side (686). However, curve was the most repeated pattern seen on both sides. The results of this study were in accordance with Indira et al. (2011) who reported more rugae on the right side than on left and suggested intraoral environment as contributing factor.

On the contrary, Shetty and Premalatha (2011) found no significant differences in the total number of rugae on the right and left side of palate among both genders seen.

Conclusion

Palatal rugae serve as a reference landmark in various dental treatment modalities and can be a valuable tool for personal identification. This study found out that palatal rugae are sufficient characteristic to indicate identity through discrimination. In view of the aforementioned findings, palatal rugae can be used as a personal print. The present study concludes that the rugae pattern may be an additional method of differentiation between the Indian male and female children.

Conflict of interest

Authors have none to declare.

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