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Rugae pattern determination in health and periodontal disease

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ABSTRACT

Background

Forensic dentistry is the dental speciality that relates & applies dental knowledge to legal problems. Rugae pattern is as unique to a human as one's fingerprints & retains its shape throughout life. The anatomical position of the rugae inside the mouth keeps them well-protected from trauma & high temperature. Hence they serve as an effective landmark for forensic identification.

Aims

To find the difference in pattern of rugae between normal healthy individuals and those with periodontitis and correlation in male and female individuals.

Material and Methods

The present study included maxillary casts of attending patients who were divided into 2 groups: (1)75 normal patients and (2)75 patients having periodontitis. Palatal rugae pattern were then evaluated for the number and shape.

Results

The number of rugae was more in normal healthy individuals as compared to those with periodontitis. Circular pattern and wavy pattern was more prevalent in healthy individuals and periodontitis patients respectively. Males had more number of rugae and straight pattern was greater as compared to females who showed predominant wavy pattern.

Conclusion

Rugae pattern is a reliable reference landmark during forensic identification. Although we have found differences in pattern of rugae in normal healthy individuals and those with periodontitis, further studies are required to be carried out with a greater sample size to achieve significant results.

Keywords: Forensic, Rugae, Periodontitis

INTRODUCTION

The identification of human remains is important due to both legal and humanitarian reasons. It is based on the scientific matching of information on missing persons with unidentified human remains. Dental, fingerprints and DNA comparisons are the most common techniques used for secure identification. However, since they cannot always be used, sometimes it is necessary to apply different and less known techniques.

Forensic dentistry (odontology) is the dental speciality that relates & applies dental knowledge to legal problems. Proper forensic identification is also necessary to claim certification of death.

Visual identification is the most common method applied in forensic sciences. However, in certain incidences where hard tissues of the oral cavity are lost due to any reasons such as trauma, visual means of identification is significant in non-mutilated palatal tissues. Thus, in forensic dentistry, the unique characteristic pattern of palatal rugae can be used as an identification tool [1]. The anatomical position of the rugae inside the mouth-surrounded by cheeks, lips, tongue, buccal pad of fat, teeth & bone—keeps them well-protected from trauma & high temperatures.

Thus, they can be used reliably as a reference landmark during forensic identification. Palatal rugae in mammals are transversely running crests, which are exclusively formed by the mucosa of the hard palate except where an ossified base can be distinguished. According to the Glossary of Prosthodontic Terms-8, rugae are anatomical folds or wrinkles; the irregular fibrous connective tissue located on the anterior third of the palate. They are also called “plica palatinae” or “rugae palatine”. It is assumed that the rugae facilitate food transport through the oral cavity, prevent loss of food from the mouth and participate in food crushing. Because of the presence of tactile and gustatory receptors, rugae contribute to perception of taste, mechanical food qualities and tongue position [2]. Palatal rugae are formed in the third month in utero from the hard connective tissue covering bone. The pattern orientation is formed by about 12^{th} to 14^{th} week of prenatal life.

Histologically, the rugae are stratified squamous mainly parakeratinized epithelium on a connective tissue base, similar to the adjacent tissue of the palate. Thomas [3] reported differences in the rugae cores taken from human embryos of over 20 weeks. He found the reticulin fiber content to be very delicate and the fibroblasts to be different in amount and size from that in adjacent palatal tissue. Many researchers have studied the morphology of palatal rugae and the racial differences, but very few have studied the individuality of palatal rugae.

Due to their internal position in head they are well protected by trauma. Palatoscopy or palatal rugoscopy is the name given to the study of palatal rugae in order to establish a person's identity [4]. The application of palatal rugae patterns for personal identification was first suggested by Allen [5] in 1889. Palatal rugoscopy was first proposed in 1932, by a Spanish investigator named Trobo Hermosa [6]. In 1937, Carrea [7] conducted a detailed study and established a method to classify palatal rugae. In 1983, Brinon [7] following the studies of Carrea, divided palatal rugae into two groups (fundamental and specific) in a similar way to that done with fingerprints [6, 7].

CLASSIFICATION

Straight

These type of rugae *ran directly* from their origin to termination in a straight line.

Curved

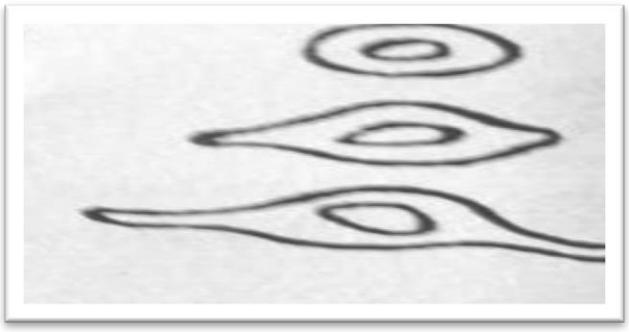
- These type have a *simple crescent shape* which curve gently.
- Slight bend at the termination or origin of rugae

Wavy

- The shape is like *serpentine*.
- There is slight curve at the origin or termination

Circular

- The rugae have a definite *continuous ring* formation



Objective of this study was to find the difference in pattern of rugae between Normal Healthy Individuals and those with Periodontitis and correlation in Male and Female individuals

MATERIAL AND METHODS

The study consisted of 2 groups of attending patients to the Department of Periodontics, Pandit Deendayal Upadhyay Dental College, Solapur, India

1) Normal patients
2) Patients having Periodontitis

The study consisted of 75 patients with normal healthy gingiva and 75 patients with Periodontitis. Informed consent was obtained from all patients according to the Helsinki Declaration of 1975 as reviewed in 2000.The study design was approved by the Ethics Committee. Patients with trauma, congenital abnormalities of palate, those undergone surgery were excluded from the study.

Alginate impression of the maxillary arch was made in stock trays. The study casts were prepared in dental plaster for interpretation. The rugae appeared as prominent ridges were delineated using a sharp graphite pencil & recorded according to the Modified Lysell Classification (1955). The recordings were made by a single examiner. Origin is that point of rugae nearest to the midline and termination is the point where the rugae end from the origin. The data collected were subjected to statistical analysis.

Fig.1

Fig. 2

Fig. 3

Fig. 1, 2, 3 Casts showing tracing of Rugae Pattern according to Modified Lysell Classification

RESULTS

In this study, the number of rugae and their pattern was studied in 150 Plaster models.

Table 1: Difference in rugae pattern between normal and periodontitis patients using Independent T-test

Rugae Pattern	Groups	Mean	Standard Deviation	Mean Difference	95% Confidence Interval for difference		T	p
					Lower	Upper		
Curved	Normal	1.4800	.92063	.42667	.13548	.71785	2.896	**.004**
	Periodontitis	1.0533	.88369					
Wavy	Normal	1.1333	.97722	-.42667	-.77571	-.07763	-2.416	**.017**
	Periodontitis	1.5600	1.17680					
Straight	Normal	1.1733	1.03157	.18667	-.12689	.50022	1.176	.241
	Periodontitis	.9867	.90782					
Circular	Normal	1.8667	1.05694	.70667	.39648	1.01686	4.502	**.000**
	Periodontitis	1.1600	.85487					

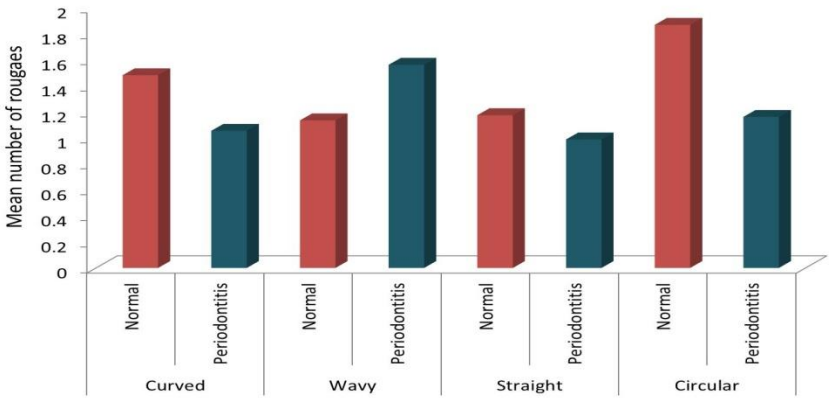


Fig.4 Difference in rugae pattern between normal and periodontitis patients

In Table 1 number of curved rugae was seen to be more in Normal patients than Periodontitis patients. The P value was found to be 0.004 which was statistically significant. Wavy pattern was more prevalent in Periodontitis patients than Normal patients, which was statistically significant

(P = 0.017).Straight pattern was seen more in Normal patients than in Periodontitis but this difference was not statistically significant. Circular pattern was seen to be statistically more significant in Normal than Periodontitis patients (P= 0.000).

Thus, it was evaluated that circular pattern was more prevalent in Normal Patients whereas wavy pattern was more prevalent in Periodontitis patients. In Tables 2,3,4,5 Distribution of subjects according to curved, wavy, straight, circular rugae pattern in normal group has been evaluated.

Table 2: Distribution of subjects according to curved rugae pattern in normal group

Number of rugae	Frequency (N)	Percentages (%)
.00	8	10.7
1.00	35	46.7
2.00	22	29.3
3.00	8	10.7
4.00	2	2.7

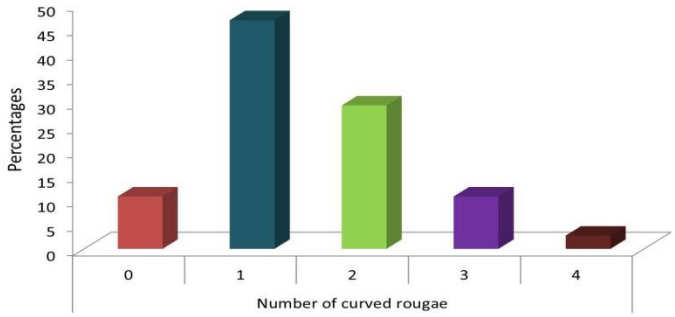


Fig.5 Distribution of subjects according to curved rugae pattern in normal group

Table 3: Distribution of subjects according to wavy rugae pattern in normal group

Number of rugae	Frequency	Percentages (%)
.00	20	26.7
1.00	33	44.0
2.00	17	22.7
3.00	2	2.7
4.00	3	4.0

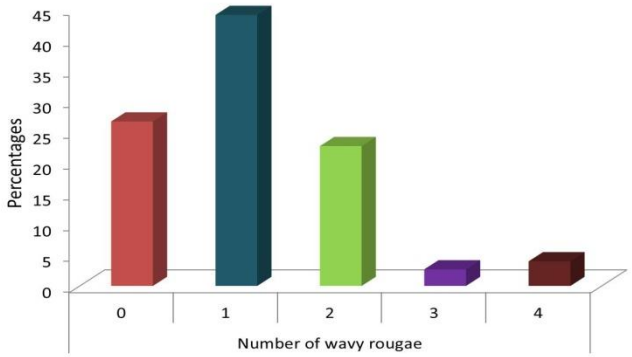


Fig.6 Distribution of subjects according to wavy rugae pattern in normal group

Table 4: Distribution of subjects according to straight rugae pattern in normal group

Number of rugae	Frequency	Percentages (%)
.00	19	25.3
1.00	36	48.0
2.00	11	14.7
3.00	6	8.0
4.00	3	4.0

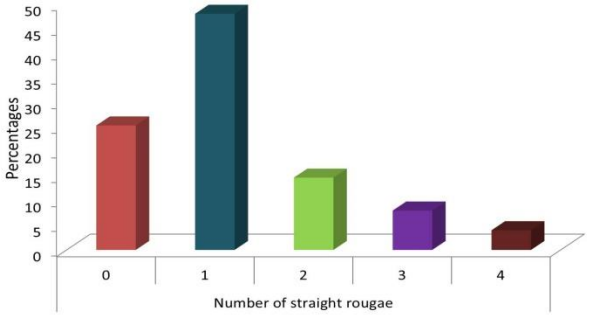


Fig. 7: Distribution of subjects according to straight rugae pattern in normal group

Table 5: Distribution of subjects according to circular rugae pattern in normal group

Number of rugae	Frequency	Percentages (%)
.00	3	4.0
1.00	30	40.0
2.00	24	32.0
3.00	10	13.3
4.00	8	10.7

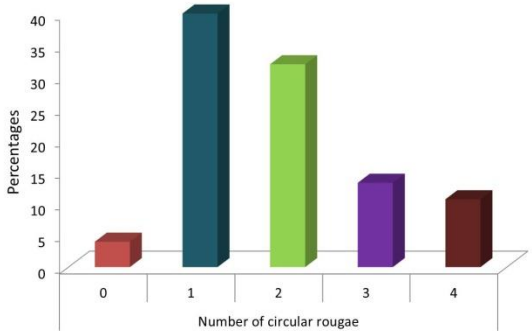


Fig. 8: Distribution of subjects according to circular rugae pattern in normal group

In Tables 6,7,8,9 Distribution of subjects according to curved, wavy, straight, circular rugae pattern in periodontitis group has been evaluated.

Table 6: Distribution of subjects according to curved rugae pattern in periodontitis group

Number of rugae	Frequency	Percentages (%)
.00	19	25.3
1.00	39	52.0
2.00	13	17.3
3.00	2	2.7
4.00	2	2.7

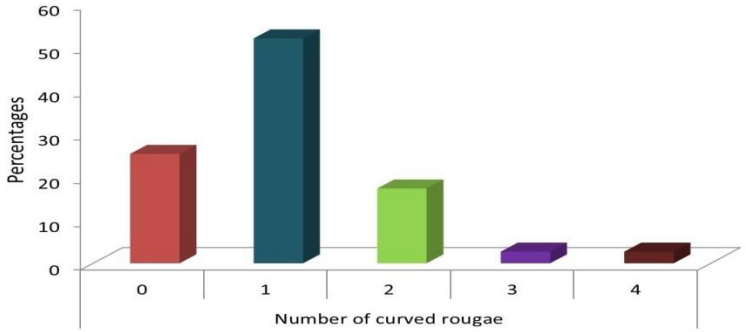


Fig.9: Distribution of subjects according to curved rugae pattern in periodontitis group

Table 7: Distribution of subjects according to wavy rugae pattern in periodontitis group

Number of rugae	Frequency	Percentages (%)
.00	11	14.7
1.00	33	44.0
2.00	16	21.3
3.00	10	13.3
4.00	3	4.0
5.00	2	2.7

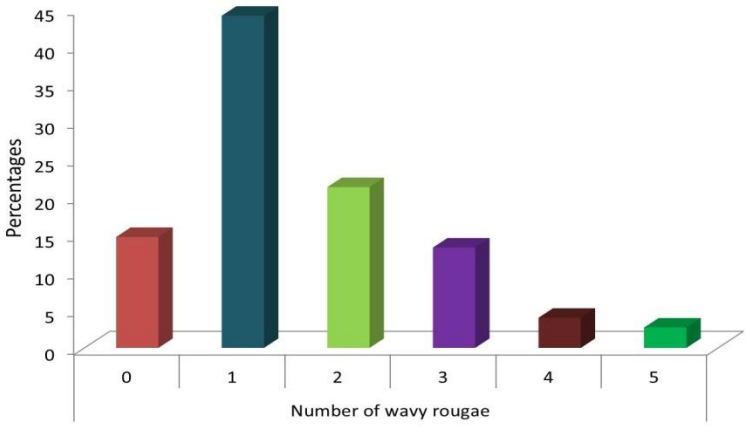


Fig.10: Distribution of subjects according to wavy rugae pattern in periodontitis group

Table 8: Distribution of subjects according to straight rugae pattern in periodontitis group

Number of rugae	Frequency	Percentages (%)
.00	24	32.0
1.00	34	45.3
2.00	12	16.0
3.00	4	5.3
4.00	1	1.3

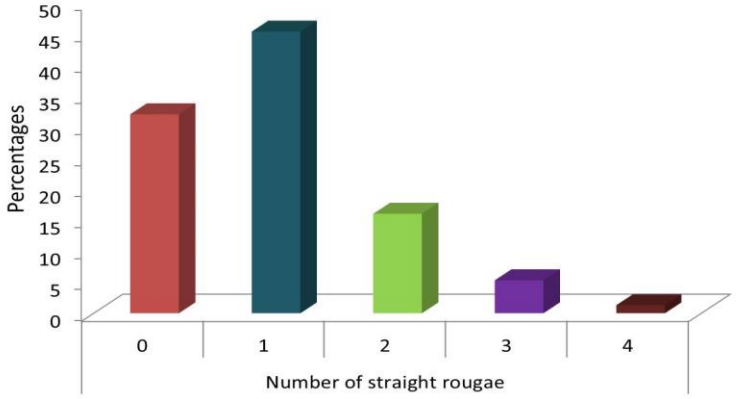


Fig. 11: Distribution of subjects according to straight rugae pattern in periodontitis group

Table 9: Distribution of subjects according to circular rugae pattern in periodontitis group

Number of rugae	Frequency	Percentages (%)
.00	15	20.0
1.00	39	52.0
2.00	16	21.3
3.00	4	5.3
4.00	1	1.3

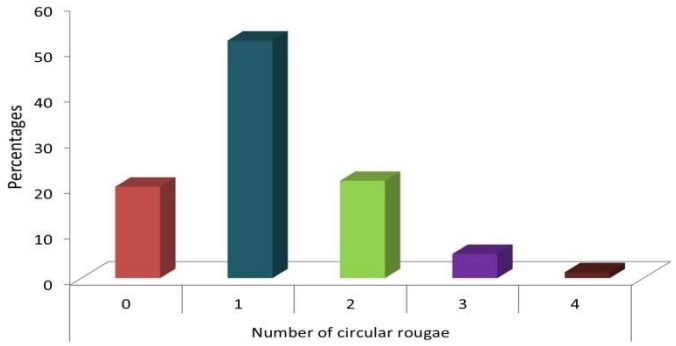


Fig. 12: Distribution of subjects according to circular rugae pattern in periodontitis group

In Table 10 ; the number of rugae was found to be more in Normal patients than those seen in Periodontitis patients and this difference was statistically significant with p = 0.007. In the Normal group, the number of rugae was 424 and it was 357 in the Periodontitis group with a mean difference of 0.22333.

Table10: Difference in total rugae pattern between normal and periodontitis patients using Independent T-test.

Groups	Mean	Standard Deviation	Mean Difference	95% Confidence Interval for difference		T	p
				Lower	Upper		
Normal	1.4133	1.03573	.22333	.06126	.38541	2.706	**.007**
Periodontitis	1.1900	.98512					

This is in contradiction to studies which prove that rugae pattern Do not change throughout life. Variations do occur in the pattern and number of rugae due to disease processes. Differences in rugae were also observed as sex varied. When compared to males and females, the number of rugae was found to be more in males than females. It was 432 in males and 349 in females. Males had predominant straight pattern whereas Females had predominant wavy pattern.

DISCUSSION

There exist certain limitations for identification by fingerprints, DNA , dental records in some situations. In such cases, rugae have been widely used in population identification. Application of palatal rugae patterns for personal identification was suggested by Allen in 1889. The term "Palatal rugoscopy" was first proposed by the Spanish investigator Trobo Hermosa [6].

There are several ways to analyze palatal rugae like calgurroscopy, stereoscopy, oral photography. In this study, the method of intraoral inspection was chosen as it is the easiest and cheapest method among the rest. There are different classification systems to analyze rugae as well. But the classification system based on shape was selected as it is easy to record and does not need complex instrumentation. Rugae shape proves to be more accurate than rugae length. Hence this classification system better suited.

In this study, both shape and number analysis was done. The size and shape of rugae pattern was compared in males and females as well as in normal patients as compared to those having periodontitis. There are numerous studies for analysis of rugae in normal population and also for gender identification [9, 10, 11, 12]. Arora et al. who compared two different populations and found that there were significant differences seen between rugae pattern of two different populations. But this study compares the rugae pattern in normal patients to those in chronic periodontitis. Jindal et.al compared the rugae pattern in patients having gingivitis, chronic periodontitis and aggressive periodontitis [13]. They used the Trobo classification for study of palatal rugae.

Kapali et al. also found that malpositioning of teeth; pathologies involving the palate could cause alteration in pattern of rugae. Extractions also cause change in position of palatal rugae adjacent to the alveolar arch [14]. Extractions can also sometimes alter the direction of palatal rugae [9]. Palatal rugae also differed in size and number when compared to males and females [15, 16].

However, there are some contradictory studies as well. According to English's studies [17], palatal rugae patterns are sufficiently characteristic to discriminate between individuals. It was stated that rugae pattern was absolutely unique to an individual and could be used for identification [18]. But our study showed differences in rugae pattern when patients with gingivitis and periodontitis were compared. As these were inflammatory conditions they could damage the pattern of rugae in individuals and make identification difficult. There were differences found in the rugae pattern in males and females as well. As the sample size considered was small, further studies with large sample size are required.

CONCLUSION

- In our study, the number of rugae was found to be more in Normal Healthy individuals as compared to those having Periodontitis.
- Circular pattern was more prevalent in healthy individuals and wavy pattern was prevalent in patients with Periodontitis.
- Males showed more number of rugae than females.
- Males had predominant straight pattern whereas Females had predominant wavy pattern.
- These findings were within the limited sample size. So further studies are warranted.

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