Comparative rugoscopic pattern analysis of dentulous and edentulous population of Rajasthan state

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Abstract

Background: In accordance of forensic dentistry, every palatal rugae has a remarkable distinct pattern in every human, it can be applied as an identification tool.

Objective: The objective of the present study was to investigate palatal rugae patterns in dentulous and edentulous patients and evaluate the reliability of these patterns in human identification.

Methodology: The study group was equally divided into 30 dentulous and 30 edentulous patients, respectively. A duly filled and signed consent form was attained from each participant. Alginate impression material is used for primary impressions in a perforated tray and dental stone (Type-3 Gypsum products) was used to develop a cast. The number, length and shape were recorded after analysing the rugae patterns. Statistical calculation done by using SPSS system.

Results: The mean of the total number of rugae more in dentulous (7095 ± 1.393) than edentulous (5.99 ± 1.001) participant. Dentulous subjects shows more curved rugae patterns (2.98 ± 1.321), primary rugae (6.86 ± 1.287) and forwarded rugae (3.84 ± 1.801) while more straight rugae patterns (3.15 ± 1.44) and perpendicular rugae (2.64 ± 1.425) found in edentulous subjects.

Conclusion: This study concludes that there is statistically significant variation in dentulous and edentulous participant in term of shape, number, size and direction.

Keywords: Dentulous, forensic identification, palatal rugae, age group.

Introduction

Personal identification is a most crucial and mandatory aspect for forensic science [1]. For authentic identification of human body DNA comparison, fingerprint, dental and visual identification methods are used in forensic sciences [2]. However, in certain incidences like

aircraft accidents, trauma and received damaged body due to any reasons such methods cannot be applicable. In that case, Palatos copy plays a major role. In accordance of forensic dentistry, every palatal rugae has a remarkable distinct pattern in every human, it can be applied as an identification tool [3].

Palatal rugae or Plica Palatine Transferase explained as a transverse ridges sequence on the anterior part of the palatal mucosa. Behind the incisive papillae each side of the median palatal raphe contains these ridge [4]. Generally human has four ridges, but in case of males they are more in number as well as left side contains more ridge in both sex. Therefore, it assists in sex determination also [5].

Palatal rugae is made up of connective tissues or we can say mucosa elevation. In the early phase of prenatal life (12th to 14th week) palatal rugae put in place, which is protected by cheek, lips and buccal pad of fat. It persistently shows stability and consistency in number with no changes due to growth, ageing, disease and external trauma [6].

In 1889, Allen was the first man, who suggested the application of palatal rugae patterns for personal identification. The Spanish investigator Trobo Hermosa, named it as a "Palatal rugoscopy" [5]. Thomas *et al* gave a classification to Identify palatal rugae pattern. This classification gave a clear picture of number, length, shape and identification pattern of rugae, which further categories into different categories as mentioned in table 1.1. [7, 8].

Table 1.1: Classification of palatal rugae patterns

No.	According to length	According to shape	Unification pattern
1.	Primary rugae (5-10 mm)	Straight-Runs directly from origin to termination	Diverging pattern-two rugae begin from the same origin but transversely diverge [9, 10].
2.	Secondary rugae (3-5 mm)	Curvy-Simple crescent shape that was curved gently	Converging pattern-two rugae begin from different regions and converge transversely [6, 7].
3.	Fragmentary rugae (less than 3 mm).	Circular-Definite, continuous formation of ring, diameter measured from origin to end is	
4.		Wavy-Serpentine form.	

The aim of this study is to investigate the palatal rugae patterns in dentulous and edentulous patients and evaluate the reliability of these patterns in human identification.

Materials and Methods

Sixty outpatients from Darshan dental college and Hospital were included in the study. The study group was equally divided into 30 dentulous and 30 edentulous patients, respectively. A duly filled and signed consent form was attained from each participant. The dentulous patients were young participants having age range 15-30 years and show complete growth by this age. The edentulous patients have age range 50-70 years and dentures were not used by participated in the study. Alginate impression material is used for primary impressions in a perforated tray and dental stone (Type-3 Gypsum products) was used to develop a cast. Cast was washed with tap water and air-dried under sunlight to get ready for analytical procedure. Under natural sunlight a magnifying lens and a pointed graphite pencil was used to imprint palatal rugae from the study model to facilitate visual assessment. Subjects with previous systemic illness, orthodontic surgery and cleft palate or lip were excluded from the study. Only young healthy subject who had fully developed palates were selected for study purpose. The number, length and shape were recorded after analysing the rugae patterns. Statistical calculation is done by using SPSS system. Student's t-test analysis and P value was determined to evaluate the significance of data.

Results

In this study, total of sixty participants were selected which were further divided into two categories, dentulous and edentulous for evaluation. All sixty casts were scrutinised according to Thomas and Kotze classification [8] in line with the number, direction, shape, length and unification patterns. When the mean of the total number of rugae in dentulous and edentulous participant was analysed, it found more in dentulous (7095 ± 1.393) than edentulous (5.99 ± 1.001) participants.

Table 3.1: Comparison of total rugae number (mean) in dentulous and edentulous subjects

Study group	Number
Dentulous (mean)	7.95
Standard Deviation	1.353
Edentulous (mean)	5.99
Standard Deviation	1.001
t value	3.980
p value	<0.01

Table 3.2: Comparison of different shapes (mean) in dentulous and edentulous subjects

Study group	Shape				
	Perpendicular	Curve	Wavy	Straight	Circular
Dentulous (mean)	1.97	2.98	0.42	2.99	0.03
Standard Deviation	1.491	1.321	0.765	1.256	0.299
Edentulous (mean)	2.64	1.86	0.10	3.15	0.01
Standard Deviation	1.425	1.242	0.261	1.44	0.05
t value	-2.775	3.875	2.897	-1.482	0.633
p value	<0.001	<0.001	<0.01	>0.05	>0.05

The mean value of study group was compared with respect to shape express more curved rugae patterns (2.98 ± 1.321) in dentulous subjects while a greater number of straight rugae patterns (3.15 ± 1.44) in edentulous subjects. (Table: 3.2)

Table 3.3: Comparison of length (mean) in dentulous and edentulous subjects

Study group	Length		
	Primary	Secondary	Fragmentary
Dentulous (mean)	6.86	0.12	0
Standard Deviation	1.287	0.376	0.000
Edentulous (mean)	5.42	0.02	0.000
Standard Deviation	1.030	0.13	0
t value	2.768	1.041	0.000
p value	<0.001	>0.05	NA

In case of length, primary rugae (6.86 ± 1.287) is more in dentulous subjects and there is no dissimilarity in the mean of secondary rugae patterns as well as converging and diverging patterns. (Table 3.3,3.4)

Table 3.4: Comparison of unification pattern (mean) in dentulous and edentulous subjects

Study group	Unification	
	Converging	Diverging
Dentulous (mean)	0.08	0.05
Standard Deviation	0.344	0.101
Edentulous (mean)	0.08	0.04
Standard Deviation	0.253	0.42
t value	0.000	-1.001
p value	>0.05	>0.05

As a term of direction, forwarded rugae (3.84 ± 1.801) are more in dentulous participant while perpendicular rugae (2.64 ± 1.425) were more in edentulous participant and there is no change in back warded rugae pattern. (Table: 3.5)

Table 3.5: Comparison of direction (mean) in dentulous and edentulous subjects

Study group	Direction	
	Forward	Backward
Dentulous (mean)	3.84	1.05
Standard Deviation	1.801	1.280
Edentulous (mean)	0.99	1.03
Standard Deviation	1.000	1.201
t value	6.550	0.201
p value	<0.001	>0.05
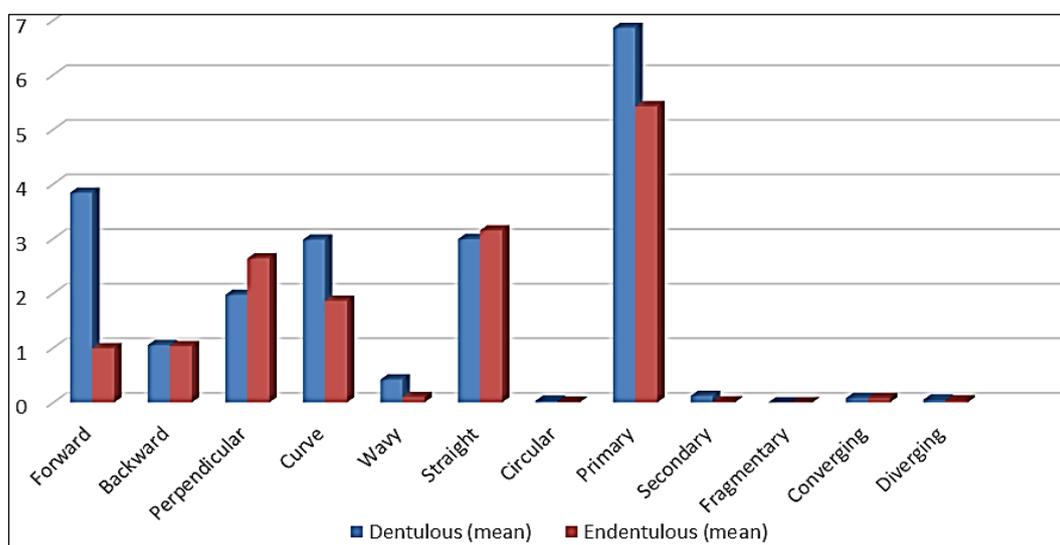
Fig 1: Camparison of edentulous and edentulous subjects according to classification of palatal rugae

Discussion

The palatal rugae is pertinent for human identification, since it is comparable as the fingerprint, unrepeatable for each personage, stable and ancestral existence [11, 12]. The main function of the palatal rugae are swallowing food, cooperate in speech and take part in the suction in children.

The anatomical position of the rugae makes it intact throughout the life, until there is no physical alteration on the tissue. As well as it is fairly stable and with stand decay for a few

days after death [13, 14]. On the counterpart it may make some changes due to finger sucking for long period in kids and external pressure by dental surgery. But it is easy, reliable and economical which makes is appropriate for forensic identification along with that it shows distinct difference between two palatal rugae configurations, which is remarkable [14].

This study followed classification given by Thomas and Kotze [8] which further divided into the number, direction, shape, length and unification patterns. In the present study, most prominent rugae shapes found between two study groups were straight and curved followed by wavy and circular. These outcomes moderately matches with Christine Roy *et al*. [15]. In the case of direction, dentulous participant had more forwardly directed rugae however edentulous participant had more number of perpendicular rugae. Basically both participant groups reported almost same backwardly directed rugae pattern. These study outcomes were in contrast with the results of by Shubha C *et al*. [16], which displays noticeable backward direction.

In the past study of Jawad IA [17], dentulous participant revealed more circular and wavy forms than edentulous participant; whereas curved and straight shapes were most visible. This finding goes in agreement with current study.

As per review of literature, the rugae remains equally stable in number and structure except there is a case of extreme finger sucking, trauma, and orthodontic association, which may transform the alignment [18, 19]. The lateral ends of rugae position were illustrate substantial changes were supposed to follows the tooth migration direction which generally occurs after the loss of neighbouring teeth in correlation with the bone resorption [17, 20]. The results were same as our study, where a migration of the rugae in the direction of the ridge appeared in long standing edentulous participants.

Conclusion

The previous studies gave evidence of variations in palatal rugae pattern after aging and tooth loss. Thus this study is significate statistically and agree with the more complex number of rugae pattern in the dentulous participant while more simple and straight pattern in the edentulous participant. As compare to senior people young people contains more rugae in number which are complex, bidirectional and long however senior subjects has more perpendicular rugae.

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