ORIGINAL ARTICLE

Determination of Gender by Palatal Rugae Print

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Abstract :

Identification of a person "living or dead" is an important task in forensic medicine and it can be partial or complete. There are several situations where establishment of complete identification is not possible such as in plane crashes, railway accidents, building collapses, burnt or mutilated bodies etc. In such situations partial identification is required where certain major criteria's are taken into consideration such as age, gender, race and stature of a person. Determination of gender of a person forms one of the important criteria of partial identification of a person. Gender determination can be estimated by several methods such as dental data, karyotyping and skeleton remains. Adding to this we have conducted a study on palatal rugae to look for any sexual dimorphism, which have been observed in several studies conducted in past. To determine the gender of a person from palatal rugae print, this study was carried out in SSIMS & RC, Davangere, Karnataka. The maxillary casts of 250 subjects (125 males and 125 females) within age range of 12-25 years were taken into consideration and were analyzed by using SPSS student unpaired 'T' test. Several parameters were taken into consideration among which few had shown statistically significant variation in both sexes. The result of this study indicates that there is gender differentiation in palatal rugae print, so this can be efficiently used for determination of gender of a person.

Keywords : Identification; Palatal Rugae; Gender.

Introduction :

Identification is the determination of the individuality of a person based on certain physical characteristics.[1] There are many methods used for identification of a person viz : visual identification, fingerprints, foot prints, dental characteristics and DNA finger printing. In many instances, one or all of these methods may not be totally effective or conclusive.

The most common and reliable techniques used in this context allowing fast and secure identification are dental data, fingerprints and DNA comparisons. However, they cannot be always used; sometimes simple techniques can be used successfully in human identification, such as 'palatal rugoscopy' which is the study of palatal rugae. Palatal rugae have been equated with fingerprints and are unique to an individual.[2] It can be a special tool for identification and of interest in edentulous cases and also in certain conditions where there are no fingers to study, such as burned bodies or bodies that underwent advanced decomposition. Thus, the uniqueness, postmortem resistance, overall stability and additionally low utilization cost makes it ideal forensic identification parameter.

It is a new upcoming topic and analysis of previous studies done,

indicate that there is less data available in India regarding the palatal prints. Hence, present study has been taken up with an aim to study and compare the palatal rugae prints in males and females and to assess the predominant pattern in both sexes on basis of number and size of palatal rugae. So that it can be used as an ideal forensic identification tool to solve the various medico-legal cases by the forensic faculty and law enforcing authority.

Materials and Methods :

Source of data: The present study was conducted by collecting the maxillary casts of 250 subjects (125 males and 125 females) within an age group of 12 to 25 years, among the medical students at S.S. Institute of Medical Sciences & Research Centre, Davangere, the patients attending dental clinic at S.S. Institute of Medical Sciences & Research Centre, Davangere, students of Ramnagar Government School, Davangere, Bapuji Dental College, Davangere and Nutun PU college, Davangere, Karnataka.

Method of collection of data and sampling procedure: After obtaining the consent from the legal authorities, informed written consents were taken from the subjects. With aseptic precautions the maxillary dental casts were collected from the subject on alginate impression materials which were further developed into a positive cast by using dental stone material. These casts were brought to the department of Forensic Medicine and Toxicology, S.S. Institute of Medical Sciences & Research Centre, Davangere for further analysis.

Results :

The study was conducted among 250 subjects (125 males and 125

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Table 1- Showing the mean and SD of measurements of palate from right 1st premolar to left 1st premolar, both in males and females.

Gender	Number	Mean	Std Deviation
Female	125	2.355	0.203
Male	125	2.494	0.172

As per this data the palatal breadth in males and females show significant difference. (p value = 0.001)

Table 2- Depicting mean and standard deviation of the total number of rugae in both males and female and on either side.

	Right side of the palate				Left side of the palate			
	N	Mean	Mini mum	Maxi mum	N	Mean	Mini mum	Maxi mum
Female	125	4.05±.551	3	5	125	3.96±.590	3	5
Male	125	4.17±.759	3	6	125	4.38±.656	3	6
Total	250	4.11±.665	3	6	249	4.17±.657	3	6

p value on right side 0.15   p value on left side 0.001
As per the above table the total number of rugae on right and left side in both males and females do not show much significant difference.

Table 3- Showing the incidence, percentage and significance of each type of rugae in males and females on right side based on size of rugae.

Right side	Males		Females		p value
	Count	Percentage	Count	Percentage	
Primary A	236	48.8	256	52.0	0.081
Primary B	230	54.9	189	45.1	0.066
S	50	44.2	63	55.8	0.005
F	3	100	0	0	0.324

The above table states that most common type of rugae is primary 'A' which is more common in females, only secondary rugae showed significant difference.

Table 4- Showing the incidence, percentage and significance of each type of rugae in males and females on left side based on size of rugae.

Right side	Males		Females		p value
	Count	Percentage	Count	Percentage	
Primary A	260	48.2	279	51.8	0.001
Primary B	235	56.6	180	43.4	0.001
S	46	52.3	42	47.7	0.001
F	5	100	0	0	0.001

There is significant difference among males and females bases on length of rugae on left side of palate.

Table 5 - Discriminate function coefficient for sex determination considering the length of the rugae.

	Raw canonical coefficient		Class means on canonical variables			
Variables	Right side	Left side	Right side		Left side	
Primary -A	0.273	1.087	Males	Females	Males	Females
Primary - B	1.185	1.661	0.245	-0.245	0.337	-0.337
Secondary	0.343	1.091	Constant	Constant		
Fragmentary	4.840	3.109	-2.736	-5.500		

Equation for right side rugae based on length:
Gender = [0.273(Primary-A) + 1.185(Primary-B) + 0.343(S) + 4.840(F)] -2.736.
If the value falls near 0.245 it is male and when the value is less than or near -0.245 it is female subject.
Equation for left side rugae based on length:
Gender = [0.273(Primary-A) + 1.185(Primary-B) + 0.343(S) + 4.840(F)] -5.500.
If the value falls near 0.337 it is male and when the value is less than or near -0.337 it is female subject.

females) in the age group of 12 years to 25 years.

Analysis was done using step wise discriminate analysis test and student unpaired 't' test to compare mean values of different parameters between 2 groups

Discussion :

It is widely acknowledged that, there are limitations in identification by fingerprints, dental records and DNA in some forensic situations and the palatal rugae pattern of an individual may be considered as a useful adjunct for identification purposes. Palatal rugae pattern is sufficiently characteristic to discriminate between individuals.[3] They are unique and identification could be based on their comparison.

The present study was carried out to study the rugae pattern in Davangere district and to compare the patterns between the males and females, which may be an additional method of differentiating the gender, especially if other methods are missing in antemortem.

A study conducted by Chopra et al.[4] in Puchkula district, Haryana, analyzed that the average palatal breadth was more in males than in females, which was in accordance with our study depicting that there was gender dimorphism with higher value for males with statistically significant difference ($p \leq 0.001$).

The studies conducted by Dhoke et al.[5] and Venegas VH et al.[6] stated that the average number of total palatal rugae were more in males than females. This is in agreement with present study, depicting the total number of rugae on right side were more in males than in females with statically difference, while as on left side it was statically significant ($p \leq 0.001$) with male predominance.

The studies conducted by Bharath ST et al.,[7] Sharma P et al.,[8] Gondiverkar SM et al.,[9] Shetty D et al.,[10] Manjunath S et al.,[11] were not in agreement with our conclusions, stating that total number of rugae were more in females than males. The studies conducted by Verma R et al[12] and Fahim MF et al.[13] concluded that no significant difference between males and females was seen on basis of total number of rugae.

Based on the size of rugae the classification put forth by Thomas and Kotze[14], who divided the rugae into four different types namely primary 'A', primary 'B', secondary and fragmentary. Based on this classification our study showed that the most common type of rugae was primary 'A', followed by primary 'B' next secondary and the least common type was fragmentary. The primary 'A' pattern on left side showed statistically significant difference ($p = 0.001$) with female predominance, while as on right side it shows female predominance with no significant difference. The primary 'B' type showed statistically significant difference ($p = 0.001$) on left side with male predominance and on right side show higher values in males with no significant difference which were in agreement with previous studies conducted by Sharma P et al.[8] and Gondivkar SM et al.[9] who stated that primary rugae are more common in females. Whereas the studies conducted by Shetty D et al.,[10] Fahim MF et al.[13] contradicts the above results showing no significant difference of primary rugae in males and females.

The study conducted by Verma R et al.[12] illustrated that secondary type of rugae show significant difference with female predominance which was in accordance to the present study

depicting that the secondary pattern of rugae on right side show female predominance with significant difference of p = 0.005, but was not in agreement on left side which shows statistically significant difference (p = 0.001) with male predominance.

On further statistical analysis raw canonical coefficients were obtained along with the class mean and constants for right side palatal rugae and left side palatal rugae, from which certain equation were made formed for length of rugae which showed 76.93% accuracy for length of rugae.

Conclusion :

The following were the conclusion drawn after analyzing the rugae patterns of maxillary casts of 250 subjects (125 males and 125 females) in and around Davangere district.

- The palatal breadth of males is greater than female with statistically significant difference (p = 0.001).

- Males have more number of rugae.

- Females have more number of secondary types of rugae on right side (p = 0.005).

- On left side of palate, the primary 'A' type of rugae show predominance in female with statistically significant difference.

- Primary 'B', secondary and fragmentary pattern of rugae shows male predominance with significant difference.

The equations:

- GENDER = [0.273(PR 'a') + 1.185(PR 'b') + 0.343(SR) + 4.840(FR)] – 2.736.

This equation holds for right side rugae classified on the basis of size. If the value is near 0.245 it is male and when it comes near – 0.245 it is female.

- GENDER = [1.087(PR 'a') + 1.661(PR 'b') + 1.091(SR) + 3.109(FR)] – 5.500.

This equation holds for left side rugae classified on the basis of size. If the value is near 0.337 it is male and when it comes near – 0.337 it is female.

Using these equations, the gender of a person can be determined. This can prove helpful when other methods of gender determination are not feasible. This is a simple and cost-effective method.

Ethical clearance: A prior approval was obtained from the Institutional Ethics Committee.

Conflict of interest: None to declare.

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