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A Study of Inheritance of Palatal Rugae Pattern Amongst 3 Generations

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Abstract

Introduction- identification of human being can be a very tricky yet difficult process in forensic investigation. There were few common techniques that is being used prominently in identification processes those were DNA profiling, fingerprint analysis, dental casting etc., but considering all this what if forensic expect won't find fingerprint right at the crime scene or don't have time to run and conclude DNA typing result because its time consuming. For that reason, we could use palatal ridges for the identification purpose.

Materials and methods- The study consider to be of 11 families, 3 generation each, 11 x 3= 33 samples in total of the Punjab region of India. After taking consent to the respected subjects. Alginate impression was taken of the maxillary arch for analysing purposes. Further the obtained dental impression was marked by graphite sharp pencil with light hand movement and the observation were recorded.

Result - From the study it was concluded that the inheritance of palatal ridges pattern among three generation is 9.09% to 18.18% similarities and among generation 1st and 3rd 18.18% to 45.45% and among generation 1st and 2nd is 9.09% to 18.18% and 2nd and 3rd is 9.09% to 45.45% and dissimilarities among three generation is 18.18% to 63.63%. maximum percentage of inheritance in palatal ridges pattern showing 1st and 3rd generation.

Conclusion - This study concludes that palatal ridge pattern is inherited and it may be helps to determine the family lineage of an individual.

Keywords: odontology, palatal rugae, inheritance, family lineage, forensic investigation.

1. INTRODUCTION

Identification of human being can be very tricky yet difficult process in forensic investigation.[1] There were few common techniques that is being used prominently in identification processes those were DNA profiling, fingerprint analysis, dental casting etc., but considering all this what if forensic expect won't find fingerprint right at the crime scene or don't have time to run and conclude DNA typing result because its time consuming. For that reason, we could use palatal ridges for the identification purpose. [1,4]

Study of palatal ridge is also called Palatoscopy or palatal Rugoscopy. Palatal ridge pattern is present on the maxillary anterior portion. Anatomically, two palatal bones were attached with the maxillary bone and it is a hard bone. In hard palatal crest make the thin central groove and bordered on both sides [median raphe]. [6] Small five to seven crest are move out from median raphe crest.[4] This smaller crest is called palatal ridge pattern. Shape of palatal ridge pattern asymmetric and irregular ridges of mucous membrane arranged in horizontal direction on both side of the median palatal raphe. Palatal ridges pattern is formed in prenatal stage [about 12th -14th weeks] and remain stable throughout the life and length of ridge

and distance between ridge are only increase. Length of palatal is increased during palatine grown. Each side of palatal 3-5 ridge are present and they never cross the centreline. [8-9]

G. Hauser et al. state that the size of palatal ridges increases with increase the length of palatal in early age of the individual. Both sides of palatal number and shape of rugae are varies. They will not extend toward the palatal posterior part and never cross the mid lines.

During the decomposed bodies, person identification or examination is not recognizable physically. After person death palatal ridge pattern are remain unaffected by decomposition changes up to 7 days. [5-6] Due to sucking finger in mouth children palatal ridge pattern can be affected. Due to some dental treatment palatal ridge pattern can be affected.

Identification of individual dead bodies [decomposition] is very difficult task for forensic science. With the help of dental remain more than 90% individual identify in mass disaster. Fingerprints, blood, etc. evidences are conventional evidences but due to the internal position of palatal ridge, it is well protected from any trauma, it can be used for individual identification. They remain unchanged by heat, disease, trauma, it can be used for individual identification. They remain unchanged by heat, disease, trauma or chemical and are recognized unique to everyone.[11]

Function of palatal ridge pattern:

1. Palatal ridge pattern is help in oral swallowing or to improve relationship between taste and food sensory receptor in dorsal surface of tongue and also help in chewing process.
2. It helps in production of speech and children's suction.

Figure 1: showing the real-life palatal ridges on the maxillary region.

According to Caldas et al. Winslow in 1753 first time describes the palatal ridge. And palatal ridge pattern anatomy first time study by Kuppler in 1897 to racial anatomic features identify. Carrea expanded a detail study in 1937 and create a way to classify palatal ridge pattern.[13-14] After one-year, new classification proposed by Da Silva and divided it into two groups: simple and composed, naming them by numbering and Trobo's classification divided into two groups simple and composed, naming by letters. Then according to palatal ridge location martin's dos Santos create a new classification. And then Brinon in 1983 following the studies of Carrea and palatal ridge divide in two parts [fundamental & specific].[12-13] Palatal ridge pattern is where fingerprints study is impossible [burned bodies or bodies in decomposition stage]. Palatal ridge pattern classification was given by different scientist. They were Goria [1911], Lopez De Leon [1924], Trobo [1932], Carrea [1937], Da silva [1938], Martins Dos Santos [1946], Lysell's [1955], Lima [1968], Tzatscheva and Jordanov [1970], Cormony system and Thomas and Kotze [1983].

For the current study we used Thomas and Kotze classification for observe the inheritance of palatal ridge pattern: -

1) Thomas and Kotze classification according to the palatal ridge pattern length.
   I. Primary ridge: 5-7mm and >5mm.
   II. Secondary ridge: 3-5mm
   III. Fragment ridge: 2-3mm

2) Thomas and Kotze classification of ridge according to their shape.
   I. Straight: the straight type of ridge runs directly their origin to the end.
   II. Curved: the curved type of ridge always representing simple crescent shape which curved gently.
   III. Wavy: wavy ridge is serpentine in nature.
   IV. Circular: circular ridge shows definite continuous ring.

V. Unification: unification ridge is joined at the origin and at the end. They are basically two types.

- Diverging unification: unification in which 2 started from the same origin and immediately diverged in 2 ridges.
- Converging unification: two ridge origin are different and they are joined at the end of ridge.

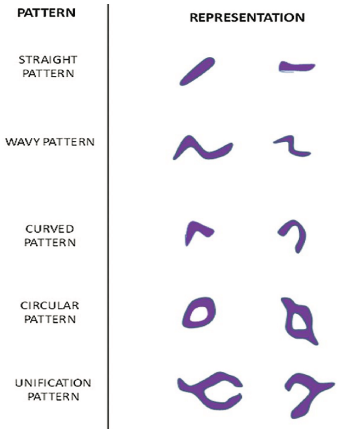

Figure 2: showing the different patterns of palatal ridge.

3) Thomas and Kotze classification according to angle of ridge.
   I. Positive angle: the lines of joining of ridge from its origin forwardly directed is called positive angle.
   II. Negative angle: the lines of joining of ridge from its origin backwardly directed is called negative angle.
   III. Zero angle: line of joining of ridge from its origin is perpendicular associated by zero angle.

I attempt this study to observed the inheritance of palatal ridge pattern among three generation so it will help in individua1 identification by lineage the family.

2. METHODOLOGY

- **Collection of samples**- In the study samples were collected from 11 families amongst 3 generation each, 11*3=33 samples in total of the Punjab region of India.

Figure 4: showing the dental alginate impression.

- **Preparation of dental cast-**

Figure 5: showing dental cast making material.

[For the preparation of dental cast , 18g alginate impression material was mixed with 36ml distilled water and 100g dental stone class iii was mixed with 30ml of distilled water.

❖ **Collection of dental samples-**

Samples were collected from the willing individual (oral and written consent taken)of upper jaw for identification and comparison for check the inheritance of palatal ridge pattern. The material was used for make the impression was alginate powder and after impression taken dental cast was make by dental stone powder. Alginate powder was mixed with the water and this paste was poured on the perforated tray and placed in mouth and dental impression was imprinted within 2 minutes. After impression , the dental stone was mixed with the water and this paste poured on the dental impression and dental caste was prepared within 30-45minutes.The precaution should be taken that it should free from bubbles and void.

❖ **Method of identification-**

- Ridge pattern on caste were marked with the help of pencil under sufficient light and by using magnification hand lens. The ridge pattern analysis was done according to Thomas and Kotze classification [1983]. The measurement of ridge pattern was performed with the help of calibre n millimetres.
- Observation the ridge pattern according to length of ridge.
  - (i) Primary ridge: 5-7mm and >5mm
  - (ii) Secondary ridge: 3-5mm
  - (iii) Fragmented ridge: 2-3mm

  [Less than 2mm ridge pattern are not considered in Thomas and Kotze classification]
- Observation was noted related to the shape of ridge with the help of hand lens and angle of ridge.

3. STATISTICS

Table 1: Inheritance on the basis of total no. of ridge in percentage.

Total no of families	primary inheritence %	secondary inheritence%	fragmented inheritance %	Total inheritance %
Similarities in all three generation	18.18%	18.18%	nil	9.09%
Similarities in 1st to 3rd generation	18.18%	Nil	18.18%	18.18%
Similarities in 2nd to 3rd generation	9.09%	9.09%	nil	45.45%
Similarities in 1st to 2nd generation	9.09%	9.09%	18.18%	nil
Dissimilarities in all three generation	45.45%	63.63%	63.63%	27.27%

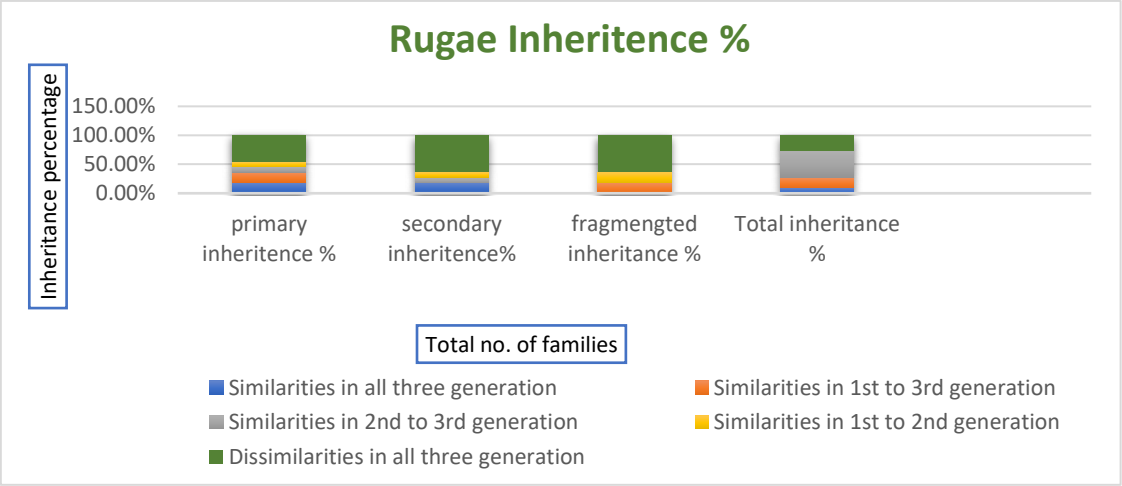

Figure 6: Showing the chart Inheritance on the basis of total no. of ridge in percentage.

Table 2: Inheritance on the basis of right ridge percentage of the palatal ridge in all 3 generation.

Total no of families	primary right ridge%	secondary right ridge %	fragmented right ridge %	Total right ridge %
Similarities in all three generation	9.09%	9.09%	nil	nil
Similarities in 1st to 3rd generation	9.09%	nil	nil	9.09%
Similarities in 2nd to 3rd generation	36.36%	27.27%	nil	27.27%
Similarities in 1st to 2nd generation	18.18%	9.09%	18.18%	9.09%
Dissimilarities in all three generation	27.27%	54.54%	81.81%	54.54%

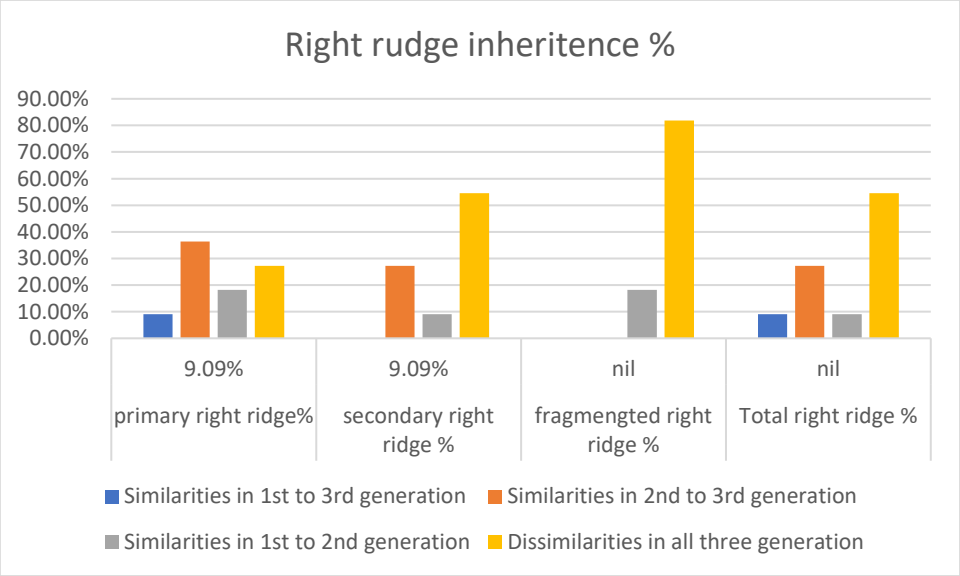

Figure 7: Showing the chart Inheritance on the basis of right ridge percentage of the palatal ridge in all 3 generation.

Table 3: Inheritance on the basis of left ridge percentage of the palatal ridge in all 3 generation.

Total no of families	primary left ridge%	secondary left ridge %	fragmented left ridge %	Total left ridge %
Similarities in all three generation	nil	nil	nil	18.18%
Similarities in 1st to 3rd generation	36.36%	nil	nil	27.27%
Similarities in 2nd to 3rd generation	27.27%	27.27%	27.27%	18.18%
Similarities in 1st to 2nd generation	18.18%	nil	nil	9.09%
Dissimilarities in all three generation	18.18%	72.72%	72.72%	27.27%

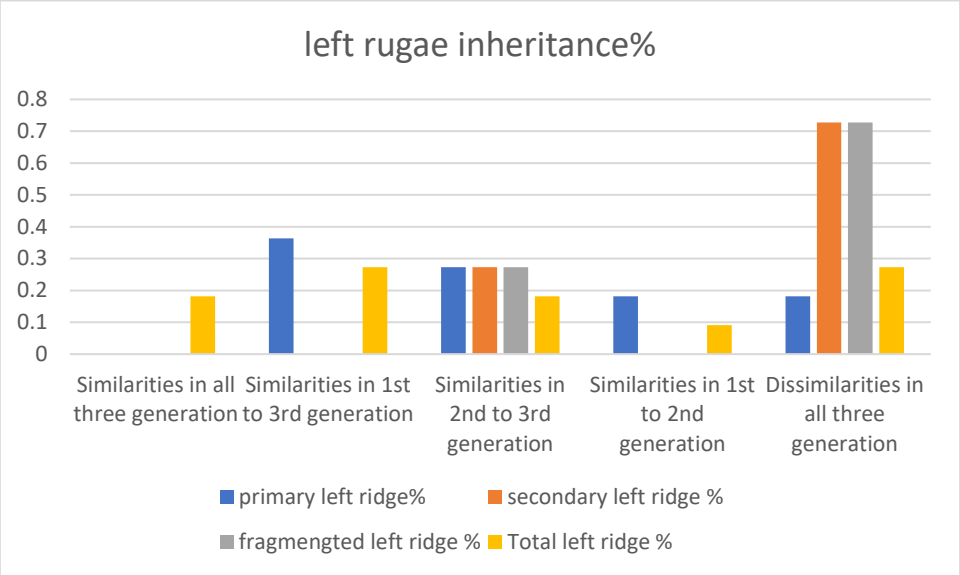

Figure 8: Showing the chart Inheritance on the basis of left ridge percentage of the palatal ridge in all 3 generation.

4. Result and discussion

Parameter 1- Inheritance on the basis of total ridge pattern.

The palatal rugae pattern sample was collected from 11 families [11*3=33 individual].

The study shows in table 4.1, percentage of inheritance on the basis of total number of ridges amongst 3 generation is 9.09% and in 1st and 3rd generation is 18.18% and in 2nd and 3rd generation is 45.45% and dissimilarities among three generation is 27.27%. this study shows the % of inheritance. The study of primary ridge amongst 3 generation is 18.18% and in 1st and 3rd generation is 18.18% and in 2nd and 3rd is 9.09% and in 1st and 3rd generation 9.09% and dissimilarities amongst three generation is 45.45%. The study of secondary ridge amongst 3 generation is 18.18% in 2nd and 3rd generation is 9.09% and in 1st and 2nd generation 9.09% and generation is 63.63%. the study of fragmented ridge in 1st and 3rd generation is 18.18% and in 1st and 2nd generation 18.18% and dissimilarities among three generation is 63.63%

Parameter 2- inheritance on the basis of right ridge pattern.

The study shows the percentage of inheritance on the basis of total number of right ridge pattern in 1st and 3rd generation is 9.09% and in 2nd and 3rd generation is 27.27% and in 1st and 2nd is 9.09% and dissimilarities among three generation is 54.54%. the study shows in table 4.1 concludes that the study of right ridge pattern of inheritance on the basis of primary ridge is 9.09% in 1st and 3rd generation is 9.09% and in 2nd and 3rd generation is 9.09% and in 1st and 2nd generation 18.18% and dissimilarities among three generation is 27.27%. the study showing the secondary right ridge pattern inheritance % amongst 3 generation is 9.09% and in 2nd and 3rd generation is 27.27% and I 1st and 2nd generation 9.09% and dissimilarities amongst three generation is 54.54%. the percentage of inheritance of fragmented ridge of right side in 1st and 2nd generation is 18.18% and dissimilarities amongst 3 generation is 81.81%.

Parameter 3: Inheritance on the basis of left ridge pattern.

The study shows in table 4.3 the percentage of inheritance on the basis of total number of left ridge pattern amongst 3 generation is 18.18% and in 1st and 3rd generation is 27.27% and in 2nd and 3rd generation is 18.18% and 1st and 2nd are 9.09% and dissimilarities amongst three generation is 27.27%. the primary left ridge pattern inheritance in 1st and 3rd generation is 36.36% and in 2nd and 3rd 27.27% and in 1st and 2nd generation 18.18% and dissimilarities amongst three generation is 18.18%. secondary left ridge pattern inheritance in 2nd and 3rd generation is 27.27% and dissimilarities amongst three generation is 72.72%.the fragmented left ridge pattern shows the percentage of inheritance of 3 generation in 2nd and 3rd is 27.27% and dissimilarities amongst 3 generation is 72.72%.

5. Conclusion

the study shows the inheritance pattern amongst three generation bases on the length of palatal ridge pattern. In this study, palatal ridge pattern examinate according to the Thomas and Kotze classification. This study was carried on the basis of following parameters:

- Inheritance of ridge pattern analysed amongst 3 generation on total ridge pattern.
- Left ridge pattern and right ridge pattern analysed separately amongst three generation.

From the study it was concluded that the inheritance of palatal ridge pattern amongst three generation is 9.09% to18.18% and in 2nd and 3rd 9.09% to 45.45% and dissimilarities amongst three generation is 18.18% and 63.63%. maximum percentage of inheritance in palatal ridge pattern showing in 1st to 3rd generation.

This study concludes that palatal ridges pattern is inheritable and it may be help to determine the family lineage of the individual. They are individualistic. If research will be performed on the greater population, it can be considering more significant results as many cases reported with bite marks[15] have good significant palatal rugae evidence.

6. Acknowledgement

I would like to thank many people who gave consent for giving samples and made this work successful and organization who have supported me in accomplishing this dissertation work.

7. Conflict of interest

No potential conflict of interest relevant to this research was reported.

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