

PALATAL RUGAE PATTERN – AN AID FOR SEX DETERMINATION

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ABSTRACT:

Background: Palatal rugae's uniqueness, its resistance to heat, and stability throughout life have been proved by its use as an alternative aid in individual identification where comparison of fingerprints and other records. Palatal rugoscopy, or palatoscopy, is the process by which human identification can be obtained by inspecting the transverse palatal rugae inside the mouth. The rugae patterns are unaffected by physical and chemical injuries and hence can serve us reliable tool in sex determination and forensic identification process. Hence this study was conducted to use palatal rugae as an effective mode for sex differentiation.

Materials and Methods: 50 patients attending outpatient department in a dental college were selected based on convenience sampling technique, out of which 25 were males and 25 were females. Maxillary alginate impression was taken and the obtained maxillary cast was visualised to identify the palatal rugae pattern according to Thomas and Kotze classification. Data was subjected to statistical analysis.

Results: A total of 756 rugae were found in the 50 individuals. Out of these, 401 (53.04%) were found in males and 355 (46.96%) in females. Hence, number of rugae and type of rugae (wavy, curvy, straight) were more in males compared to females.

Conclusion: The uniqueness and overall stability of palatal rugae suggests their use as a viable alternative for forensic identification in different groups. Researches have to be conducted in larger sample sizes, encompassing various geographical areas, for better statistically significant results, for which records are a necessity.

Keywords: palatal, rugae, rugoscopy, sex identification, Thomas and Kutze

INTRODUCTION:

According to a histological study of the development in mice, palatal rugae develop in the third month of intrauterine life as localised regions of epithelial proliferation and thickening even before the elevation of the palatal shelves.[1] Later, fibroblasts and collagen fibres accumulate in the connective tissue beneath the thickened epithelium and attain a distinctive orientation.[2] Physiologically the palatal rugae serves as an aid in oral swallowing, taste perception, speech, suction in children and in the medico-legal identification process.[3]

The identification of sex is of significance in case of major disasters where bodies are often damaged beyond recognition. On predicting the sex it builds the biological profile of the unidentified human remains thereby excluding about half the population in search operations.

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. Identification of palatal rugae pattern is based on classification by Thomas *et al.* This classification includes number, length, shape and identification pattern of rugae. By determining the length of all rugae, three categories are identified.

1. Primary rugae (5-10 mm)
2. Secondary rugae (3-5 mm)
3. Fragmentary rugae (less than 3 mm).

The characteristic pattern of the palatal rugae does not change as a result of growth and remains stable from time of development until the oral mucosa degenerates at death.(4)

Palatal rugae is selected in forensics as it is relevant for human identification due to its internal position, stability, perennity[5] i.e., it persists throughout life. Also, its design and structure are invariably unchanged and not altered by routine chemicals like nicotine, ethanol, acetyl salicylate etc., consumed heat, disease or trauma. There are reports published that the number of rugae remains unchanged throughout life but the size and pattern of arrangement changes with palatal development.[6] In addition, the rugae pattern appears to be specific to racial groups facilitating population identification.

Palatal rugae, is called the rugae palatine, and the plicae palatine, which are located in the anterior third of the hard mucosal palate in the roof of the mouth. The rugae are anatomical grooves, folds, or wrinkles with irregular, asymmetric ridges extending laterally from the incisive papilla (IP) and the anterior part of the median palatal raphe. Their number, shape, length, width, prominence, and orientation vary on each side of the midline and among different individuals. The palatal rugae never cross the midline and are numbered separately from anterior to posterior on each side of the palate. Palatoscopy or palate rugoscopy is the name given to the investigation of palatal rugae in order to establish a person's identity.[4,5,6,7,8] Rugoscopy is an important area of study that is of relevance in anthropology, comparative anatomy, genetics, forensic odontology, prosthodontics and orthodontics [9].

This method is effective because, it can be employed in cases where:

- A person is edentulous and can't be identified with the aid of teeth or
- In cases of trauma or incineration (no fingers), when other tissues get damaged, the rugae will remain protected by the surrounding structures(insulated by tongue and buccal pad of fat) due to their internal location.
- It can be used at times of disasters, for identification of the victims.
- For a reliable ante-mortem identification because of its uniqueness, stability and post mortem resistance.

The literature shows that palatal rugae are unique and permanent for each person and can be used for human identification.[9,10] Concerns have been raised about the possibility of changes in palatal rugae patterns as a result of growth, orthodontic treatment, palatal expansion, and extractions of adjacent teeth.[11,12,13,14,15,16]

There are several techniques for analysing palatal rugae. They range from complex procedures like stereoscopy, calcorrugoscopy, oral photography to simpler methods like intraoral replication and inspection of palatal rugae. Study of the maxillary cast for rugae pattern is the most simple and reliable method.

Palatal rugae show minute variations in its presentations. Numerous classification of palatal rugae has been done based on length, shape, number, and direction. Most of the methods mentioned above are quite complex and cumbersome to apply. Tracing and visualization of rugae shape on the maxillary cast has been considered the most simple and reliable method. Though it has the disadvantage of being subjective it is considered to be the most simple and reliable method. The use of stone casts for the duplication of palatal rugae from the maxillary tissues is justified, as reported by earlier studies that have shown 79% accuracy in rugae tracings using stone casts

MATERIALS AND METHOD:

The present study was conducted at a dental college in Chennai, India. All individuals of the study belong to the same geographical population from Tamil Nadu. The study sample consisted of 50 patients, of which 25 were males and 25 were female, who were selected by convenience sampling technique.

Maxillary impression trays were chosen according to the shape and size which suits the patient's arches. Two levels of alginate impression material were taken in the scoop and mixed with 40 ml of water (using a measuring jar provided by the manufacturer), in a water/powder (W/P) ratio of 40 ml: 15 g, in a flexible rubber bowl with a mixing spatula (17). Mixing was done with figure eight motion vigorously. The mix was immediately transferred to the impression tray for insertion into the patient's mouth. The tray was held passively and motionless during the setting of impression material. After about 2 minutes (setting time of Alginate), the tray was separated quickly from the teeth to avoid rocking and possible deformation of the fine areas of the impression. Excess material at the periphery was trimmed. Dental stone was mixed and poured on alginate impression tray. The cast was separated from the impression after 60 minutes. The rugae were highlighted by a sharp graphite pencil on the cast.

Rugae pattern can be classified according to Thomas and Kotze:

The rugae were divided based on their shape as:

- Curved: They had a crescent shape and curved gently. Evidence of even the slightest bend at origin or termination of a rugae led to it being classified as a curved rugae.
- Wavy: If there was a slight curve at the origin or termination of a curved rugae, it was classified wavy.
- Straight: They run directly from their origin to termination.

- Circular: Rugae that form a definite continuous ring were classified as circular rugae.
- Unification was said to have occurred when two rugae are joined at their origin or termination
- Diverging- If two rugae had the same origin from the midline but immediately branched.
- Converging - Rugae with different origins from midline, but which joined on their lateral portions. 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.

It was a single blind study. One investigator carried out sample selection and maxillary stone cast making. The cast were numbered. Another investigator was blinded regarding whether the cast belong to male or female. Only the number assigned for the cast is recorded with the type and number of different palatal rugae pattern. The obtained data was subjected to statistical analysis.



Fig.1: Palatal rugae pattern

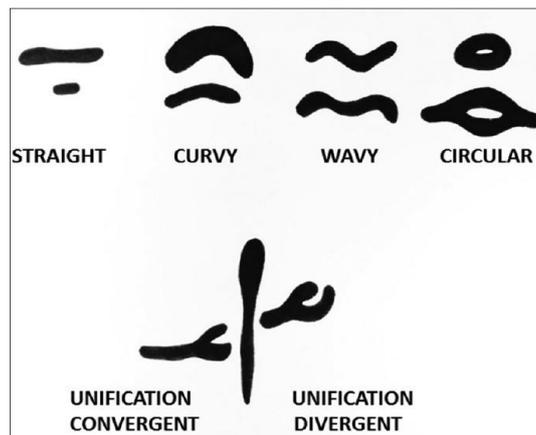


Fig 2: Thomas & Kutze Classification of palatal rugae

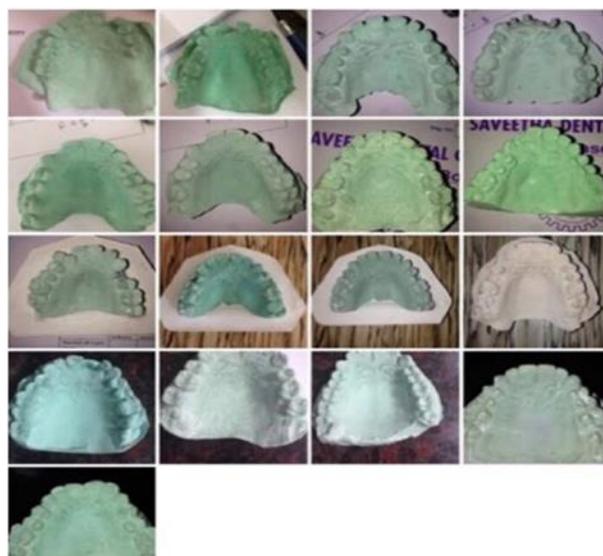


Figure 3: Casts used in the research



Fig.4: Palatal rugae identified and marked on a stone cast

RESULTS:

A total of 756 rugae were found in the 50 individuals. Out of these, 401 (53.04%) were found in males and 355 (46.96%) in females.

Straight, wavy and curvy patterns were only identified in the casts obtained. Under straight pattern, males had more number of rugae 52% compared to females 47%.

Similar trend was observed in wavy (males 58%, females 41%) and curvy (males 51, females 48%) pattern.

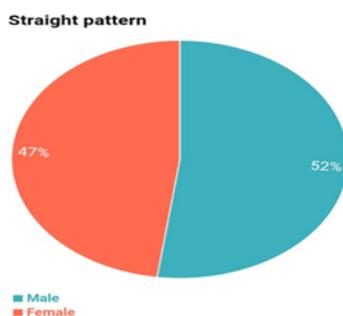


Fig.5 Straight pattern in males and females

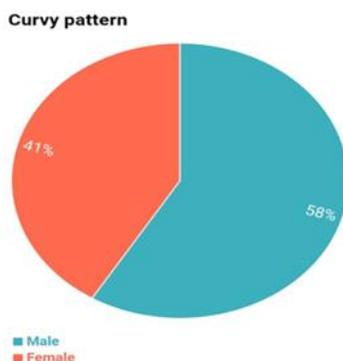


Fig 6: Curvy Pattern in males and females

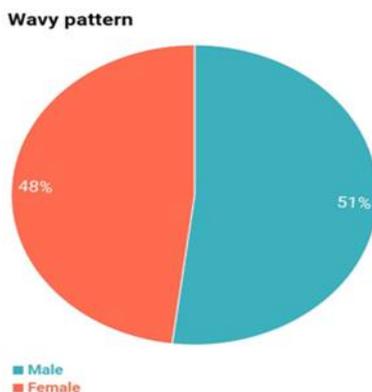


Fig 7: Wavy Pattern in males and females

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.

A total of 756 rugae were found in the 50 individuals. Out of these, 401 (53.04%) were found in males and 355 (46.96%) in females. Straight, curvy and wavy patterns appears to be common in our study. The results of this research didn't coincide with other studies, such as the one by Kapali et al (Australian Dental Journal) as the prevalence of curvy and wavy rugae patterns was more than that of straight and circular patterns. The males had more number of rugae than the females and unification pattern showed no prominence in this research unlike in other studies. There were no circle pattern on the sample type analysed in a study by Palatinas R,(18) de su Forma SD.

The characteristic pattern of the palatal rugae does not change as a result of growth and remains stable from time of development until the oral mucosa degenerates at death. Events such as trauma, extreme finger sucking in infancy and persistent pressure from orthodontic treatment and dentures can contribute to the change in rugae patterns. Changes in rugae form seen in diseases, chemical aggression or trauma are less pronounced than those seen in the generalized body state. The palatal rugae have the ability to resist decomposition for up to seven days after death.

Researchers had found difficulty in the task of classification of the rugae patterns due to the subjective nature of observation and interpretation within and between observers. Numerous classifications have been devised by several authors to record the palatal rugae patterns and unification of palatal rugae in South Indian amongst all, Silva, Lysell, Thomas and Kotze. Classifications are often used in recording the patterns. Thomas and Kotze in their literature highlighted the difficulties in observing, classifying and interpreting the limitless and minute variations in palatal rugae and emphasized the necessity for standardizing the procedures in recording. After a thorough review on all classifications from the literature, the method of identification used in this study (Thomas et al, 1983) was found to be the most practical and easy to apply compared with other methods.

According to Thomas 1983, palatal rugae do not undergo any changes except in length, throughout a person's life. Van der Linden in 1978 also stated that the changes in the length of rugae with age result from underlying palatal growth. The anterior rugae do not increase in length after 10 years of age. The mean rugae count and other qualitative characteristics such as shape, direction and unification remains unchanged throughout the life. In contrast, Lysell in 1955 stated that the number of rugae decreased from 23 years of age onwards. Hence, in the present study the age range of 18 to 35 years was considered. In the present study, there were no significant quantitative and qualitative differences found in rugae pattern between males and females. Earlier studies of J.D. Simmons et al (1987), Kapali S (1997) found gender differences to be inconclusive. (19,20)

Wavy rugae shapes were most commonly observed in the present study followed by straight and curved shape. The rugae shape is a discrete variable, which provides better results than using continuous variables like rugae measurements. It retains its shape throughout the life.

The unification of the rugae showed predominant covering pattern in males and diverging pattern among females.

CONCLUSION:

The uniqueness and overall stability of palatal rugae suggests their use as a viable alternative for forensic identification in different groups (21). Hence, the study of palatal rugae is one of the simple and reliable tools for population identification in forensic science. This study was done to look for variations in the rugae patterns. In this study, the main focus was on the primary and secondary rugae, it would be much better if fragmentary rugae are also included in the evaluation methods, to obtain better results. Though this is a questionable identification technique, it is still viable because the general configuration of rugae never changes and comparison can be done with the individual characteristics. Researches have to be conducted in larger sample sizes, encompassing various geographical areas, for better statistically significant results, for which records are a necessity. Private practitioners don't often keep proper records of their patients, so this necessitates the responsibility to maintain proper dental records to help in forensic identification.

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