Palatoscopy: An adjunct to forensic odontology: A comparative study among five different populations of India

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Abstract

Objectives: This study was conducted to analyze and identify differences in the palatal rugae patterns and to identify gender wise changes in the palatal rugae shapes in populations of five different states of India. **Study Design:** Study was conducted in five different Indian states. 500 sample subjects from Andhra Pradesh, Tamil Nadu, Karnataka, Madhya Pradesh and Maharashtra were included. Rugae patterns with predominant shapes were analyzed and categorized according to different states and both genders, data was statistically analyzed using SPSS software 15.0 and the results were obtained by Chi-square analysis. **Results:** "Wavy" type of palatal rugae pattern is the most predominant variant in five different study groups in both the genders. **Conclusion:** This study could identify variations in distribution of various palatal rugae pattern in five different states and confirmed the "wavy" type of palatal rugae patterns to be the most predominant variant in five different study groups.

Key words: Forensic odontology, palatal rugae, palatoscopy

INTRODUCTION

The use of teeth in postmortem identification has gained prominence over the last half-century. Methods of identification of an individual commonly employed are visual identification, fingerprint, dental records comparison and DNA profiling. Dental tissues particularly teeth have been shown to withstand adverse conditions like trauma, fire, accidents, decomposition and others.

Among the oral tissues, palatal rugae are permanent,

unique to each individual and can establish identity through discrimination. Palatal rugae, due to their internal position, are protected from trauma and high temperatures by lips, cheek, tongue and buccal pad of fat, teeth and bone; and do not demonstrate age related changes. In spite of these merits, rugae have not often been used as a widespread forensic tool. They have been equated with fingerprints and are unique to an individual.[1,2] Rugae pattern are specific to racial groups facilitating population identification.

So there was a need to know about palatal rugae patterns in different populations groups in various states of India. Thus, the present study was done to recognize the predominant rugae patterns and variation among different linguistic populations of five different states of India. Identification and analysis of different palatal rugae pattern was carried out along with gender wise changes in the same in limited samples of various geographically different Indian populations.

MATERIALS AND METHODS

The present study was conducted in five different linguistic populations of India in five different states. Total number of 500 sample subjects was taken from different dental colleges in various states like Andhra Pradesh, Tamil Nadu, Karnataka, Madhya Pradesh and Maharashtra.

Sample inclusion criteria

- Patient with age group of 18-30 years were considered for the study
- In each study group patients were equally considered with respect to gender that is 50 patients were males and 50 were females.

Sample exclusion criteria

- Patients with age group below 18 years and over 30 years of age
- Any pathology over the palatal region
- Patients not willing for the study.

Each study sample was examined clinically; and appropriate maxillary impression tray was selected and impressions of individual patients were taken with irreversible hydrocolloid impression material (alginate) and plaster cast was obtained by pouring with dental stone. These casts were numbered accordingly belonging to individual states and gender.

Using the classification given by Thomas *et al.*, and Kapali *et al.*[3,4] to categorize rugae shapes each plaster cast was examined.

1. Wavy: Rugae- serpentine in nature
2. Straight: Rugae- run directly from their origin to termination
3. Curved: Rugae- which have simple crescent shape and which curve gently
4. Circular: Rugae- which have definite continuous ring.
5. Unification: Two rugae joined at the origin
6. Nonspecific: Rugae with no specific origin or termination.

Each plaster cast was examined for rugae pattern and the shape of each ruga was outlined with 5 HB Figureite pencil to delineate clearly each rugae. Various rugae patterns with predominant shapes were analyzed and categorized according to different group's state wise and gender wise and the obtained data was further statistically analyzed by using SPSS software 15 and results were obtained accordingly by using Chi-square analyses.

RESULTS

It was found that "wavy" pattern of palatal rugae was the most predominant pattern seen most commonly in all the different study groups, which was followed by straight and curved pattern in all the groups except in state of Tamil Nadu where curved type of palatal rugae was second predominant after wavy rugae pattern. Frequency distribution of different rugae shapes in five different states of India which showed statistically significant Chi-square = 33.3480, degree of freedom = 12, and $P = 0.0008$ values with predominant "wavy" type of rugae pattern. These findings were plotted in a bar diagram [Figure 1].

Distribution of study samples according to palatal rugae patterns gender wise in total patients of all the states showed 74% wavy, 12.80% straight, 12% curved, unification 1.2% in males and 72.4% wavy, 14% straight, curved 12.40%, unification 1.2% in females respectively. These findings were plotted in a bar diagram [Figure 2].

Distribution of wavy pattern of palatal rugae in various study groups showed 76% in Andhra Pradesh, 58% in Tamil Nadu, 80% Karnataka, 92% in Madhya Pradesh,
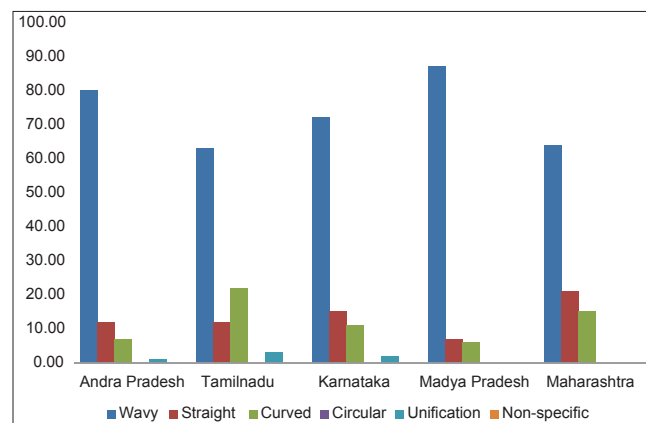
Figure 1: Bar diagram depicting the frequency distribution of different palatal rugae shapes in different states of India
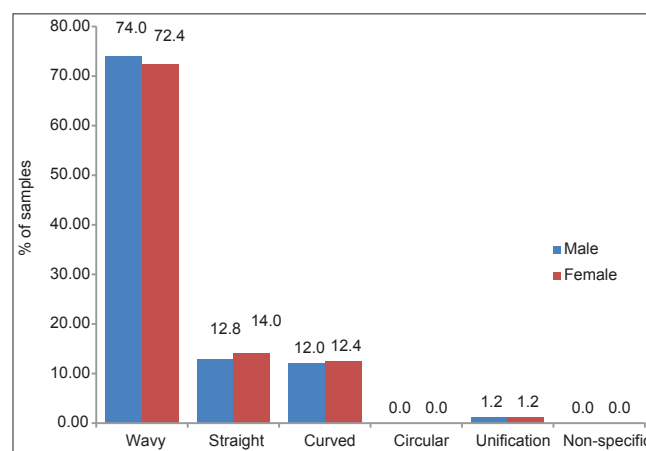
Figure 2: Bar diagram depicting the distribution of study samples according to palatal rugae patterns according to the gender in total for all the states

64% in Maharashtra in males and in females showed 84% in Andhra Pradesh, 68% in Tamil Nadu, 64% Karnataka in population, 82% in Madhya Pradesh, 64% in Maharashtra.

Straight type of palatal rugae in males showed 14% in Andhra Pradesh population, 12% in Tamil Nadu population, 18% Karnataka in population, 8% in Madhya Pradesh, 12% in Maharashtra and in females 10% in Andhra Pradesh population, 12% in Tamil Nadu population, 12% Karnataka in population, 6% in Madhya Pradesh, and 30% in Maharashtra.

Distribution of curved pattern of palatal rugae gender wise in various study groups were 10% in Andhra Pradesh population, 24% in Tamil Nadu population, 2% Karnataka in population, nil in Madhya Pradesh, 12% in Maharashtra in males and in females 4% in Andhra Pradesh population, 20% in Tamil Nadu population, 20% Karnataka in population, 12% in Madhya Pradesh, 6% in Maharashtra population.

Unification rugae pattern were very rarely seen except 3 males in Tamil Nadu, 1 female in Andhra Pradesh, 2 females in Karnataka and total of 6 patients were found in the sample.

Circular and non specific palatal rugae pattern were not observed at all in all the groups of the study.

DISCUSSION

Palatal rugae, also called plicae palatinate transversae and rugae palatina, refer to the ridges on the anterior part of the palatal mucosa, each side of the median palatal raphe and behind the incisive papilla.[5,6]

A histological study of the development of palatal rugae in mice has shown that they develop as localized regions of epithelial proliferation and thickening even before the elevation of the palatal shelves. Subsequently, fibroblasts and collagen fibers accumulate in the connective tissue beneath the thickened epithelium and then assume a distinctive orientation. The collagen fibers running anteroposteriorly within the curve and in concentric curves across the base of each rugae determines the orientation of the rugae. In human embryos, rugae are relatively prominent and occupy most of the length of the palatal shelves at the time of their elevation.[7,8]

In our study, the frequency distribution of different rugae shapes in five different states of India showed that "wavy" type of rugae pattern was commonly found, followed by straight type in all other states except in Tamil Nadu

where curved was second predominant. This study was comparable to the study carried out by Kapali *et al.*,[3,8] where they found that the most common shapes in both ethnic groups were wavy and curved forms; whereas straight and circular types were least common.

In study done by Sharma *et al.*,[9] showed predominant shape in males and females was wavy and curved, followed by the straight pattern which was in slight contrast with our study.

In the study done by Rai *et al.*,[10] showed straight type rugae were common in North Indian population. This study helps in identifying the North Indian population and this study was not comparable to our study as we did not include any North Indian population as study group sample.

In Nayak *et al.* study,[1] the most common rugae shape observed were wavy and curved forms, accounting for more than 65% in each population and it was slightly lower compared to our study where wavy and curved forms which accounted nearly more than 84%. However the study was comparable to other type of rugae pattern i.e., unifications were few in number and circular rugae were absent totally in both of the study group compared.

Through these variation in palatal rugae in different races and populations even though they are not found in present study. Rugae pattern remain unchanged with age.

Thomas and Kotze[11] also widely said that rugae pattern do not possess strong coagulate ability between human populations.

Comparing the study between an African and European population revealed that greater number unifications and circular rugae were present which was slightly in contrast with our study as there was total absence of circular type of rugae shape in our study sample.

To conclude, the palatal rugae were prominent, permanent, and unique for individuals and so can be used as identification for forensic purposes. This is widely used in edentulous patients where dental identification is not possible and in patients where other body parts were burnt and decomposed.

Review of literature reveals that there is lot of variations in palatal rugae gender wise and in races, or various geographically different races. To show these variations most of studies were done abroad with very less number of studies in our country. So our study was aimed at identifying and analyzing those variations in palatal rugae patterns

in five geographically different states of India and also studying the variations gender wise i.e., males and females.

Our study could not identify any specific variations in distribution of various palatal rugae pattern in five different states. Further studies are required by taking larger study sample representing from various geographically different regions, to come to a specific conclusion that palatal rugae pattern variations do exist gender wise and region wise.

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