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Research Article

A Study of Palatal Rugae Patterns in the Populations of Mongoloid and Tharu Ethnic Groups of Eastern Nepal

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Abstract

Background and Cbjectives: Palatal rugae patterns are relatively unique to an individual and are well protected by the lips, buccal pad of fat and teeth. They are considered to be stable throughout life following completion of growth, although there is considerable debate on the matter, they can be used successfully in post mortem identification provided an antemortem record exists. Thus the aim of this study was to examine palatal rugae shape and pattern among two Nepalese populations.

Methods: The study was conducted in 200 maxillary casts obtained by making impressions of 200 people from two ethnic groups of Nepal. Impression of maxillary arch was obtained using alginate impression material and stone cast was made. The rugae was delineated on the cast using a sharp graphite pencil under adequate light and magnification and recorded according to classification given by Thomas and Kotze (1983).

Results: Chi-Square analysis showed significant difference in straight and curved patterns between the two populations. The mean number of primary palatal rugae in Mongoloids is 4.2 in right side and 4.8 in left side. The curved pattern is more prevalent in Mongoloids (42.81%). In Tharus, number of primary rugae is 5.6 in right side and 4.8 in left side. The straight pattern of rugae is more prevalent than other patterns in Tharu ethnic group (56.72%).

Conclusion: The number of palatal rugae on right and left sides was not significantly different in both ethnic groups. The pattern of rugae was seen different in these ethnic groups.

Keywords: Palatal rugae; Palate; Human identification

Introduction

The use of teeth in postmortem identification has gained prominence over the last half-century. Postmortem dental identification is, however, not possible in the edentulous and the palatal rugae can be used as a supplement in such instances. The rugae are ridges present on the anterior palate, just behind the incisive papilla on either side of the median palatine raphae. They have been equated with fingerprints [1] and are unique to an individual [2,3]. The rugae are well protected by the lips, buccal pad of fat and teeth and, hence, survive postmortem insults [4]. They are considered to be stable throughout life following completion of growth, [5] although there is considerable debate on the matter [6-8]. However, Thomas and van Wyk [9] successfully identified a severely burnt edentulous body by comparing the rugae to those on the victim's old denture indicating, among other things, that rugae are stable in adult life. Thus, palatal rugae appear to possess the features of an ideal forensic identification parameter uniqueness, postmortem resistance and stability. Hence, they can be used in postmortem identification provided an antemortem record exists. In addition, rugae pattern may be specific to racial groups [6,10,11] facilitating population identification (which may be required post-disasters). In fact, differences in rugae pattern have been found in relatively similar population groups [10].

The study was an attempt to find the similarities and differences in the two major ethnic groups that dwell in Eastern Nepal.

Objectives

The objective of the study was to investigate differences in the shape of the palatal rugae in two populations of Eastern Nepal (Tharus & Mongoloids) and find the association of rugae pattern to identify the populations.

Materials and Methods

This study was commenced after obtaining the ethical clearance from the Institute Ethical Review Board (IERB), BPKIHS. The sample comprised of two heterogeneous linguistic groups from different regions of eastern Nepal. After making impression with alginate impression material, 100 dental casts of each Tharu and Mongoloid ethnicity were poured and only the clean and clear casts (Figure 1) showing acceptable delineation of individual rugae were sorted into two study groups.

The rugae were delineated using a sharp graphite pencil under adequate light and magnification and recorded according to the classification given by Kapali et al. [6] (Figure 2).

The shapes of individual rugae were classified into four major types: curved, wavy, straight and circular (Figure 3).

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Figure 1: Maxillary dental cast.

Figure 2: Outlining the rugae with sharp pencil.

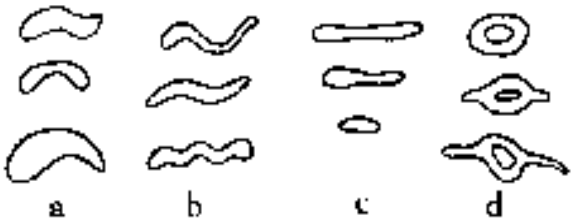

Figure 3: a – curved, b – wavy, c – straight, d – circular.

Classification of rugae

Rugae length was recorded under natural light and with a slide Vernier calipers (Figure 4) following the descriptions of Thomas and Kotze [11]. Any rugae with length less than 1.0 mm were not considered in this study. Having determined the length of all the rugae, three categories were formed:

Primary rugae: (A-5 to 10 mm; B-10 mm or more)

Secondary rugae: 3-5 mm

Fragmentary rugae: less than 3 mm.

Association between rugae shape and ethnicity as well as rugae shape and sex were tested using chi-square analysis using the SPSS 10.0 statistical package (SPSS Inc., Chicago, Illinois, U.S.A.).

Results

The incidence of different rugae shapes in the two populations is described in (Table 1). Curved rugae were the most prevalent

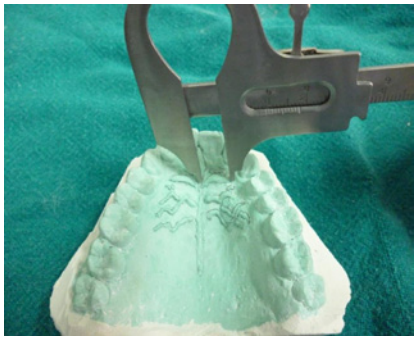

Figure 4: Measurement of the rugae length by slide calipers.

Table 1: Frequency and median of different rugae shapes in Mongoloid and Tharu population.

Rugae Pattern	Mongoloid population			Tharu population		
	incidence	*Frequency (%)*	*median*	*incidence*	*frequency*	*median*
Straight	187	28.59	3	388	56.72	4.5
Curved	280	42.81	4	163	23.83	3
Wavy	167	25.53	2.5	125	18.27	2
Circular	20	3.05	0.5	8	1.18	0.5

Table 2: Chi-square analysis for assessing differences in rugae shapes between Mongoloid and Tharus.

Rugae Pattern	Chi-square value	d.f.	P value	Inferences
Straight	28.34	7	0.008	Highly significant
Curved	18.92	6	0.02	Significant
Wavy	8.26	3	0.06	Non-significant
Circular	4.96	2	0.36	N0n-significant

Table 3: Average number of palatal rugae among two human populations (Mongoloids &Tharus).

Population group	Types of rugae	Average number of rugae		
		Right	Left	Mean
Mongoloid	Primary	4.2	4.8	4.6
	secondary	1.2	1.4	1.3
	fragmentary	0	0	0
Tharus	Primary	5.6	4.8	5.2
	secondary	1.6	1.5	1.5
	fragmentary	0	0	0

forms (42.81%) among Tharus population followed by straight rugae (28.59%) whereas Straight rugae were the most prevalent pattern (56.72%) among Tharu population followed by Curved pattern (23.83%);the difference in prevalence being statistically significant (p value 0.02) (Table 2). The differences in the number of wavy and circular rugae pattern were found to be statistically not significant (p value being 0.08 and 0.36 respectively). Straight type of pattern is highly significant while comparing the two groups.

According to length, the rugae were classified as primary, secondary and fragmentary. The result (Table 3) showed that average number of primary rugae was higher in Mongoloid than Tharu ethnic group. The number of secondary rugae was, however, similar in both

groups. Fragmentary type was rare occurrence in both study samples.

Discussion

Palatal rugae stand as a unique and stable characteristic in human identification. The present study evaluated different shapes and patterns of rugae in two ethnic groups residing in Nepal. The most predominant type of rugae shapes observed in the present study were straight and curved forms, accounting more than 65% in each population. This finding is in contrast with the study done by Kapali S et al. [6] among the Australian aborigines where wavy patterns were found maximum followed by curved ones. In a comparison of Indians and Tibetans, Shetty et al. [12] reported that the former have significantly higher numbers of curved rugae (similar to Tharus of our study) while the latter have greater incidence of wavy rugae.

Chi-square analysis showed significant population differences for straight and curved rugae (Table 2). However, no such differences were observable for the wavy forms and circular ones.

Compared with some studies done in Nepalese population, average numbers of primary, secondary and fragmentary rugae were found in contrast to both ethnic groups. The study done by more et al. [13] found number of primary, secondary and fragmentary rugae as 7.15±1.36, 0.79±1.10 and 0.36±0.68 respectively in Nepalese population. Similarly, Bajracharya et al. [14] in another study in Nepalese population had contrasting finding with mean number of primary rugae on left 3.82 and on right 3.85. These findings in Nepalese population disagree with our finding. The difference could be attributed to the reason that their studies were only taking Nepalese population irrespective to the ethnic variations.

Generally, Tharus in our study sample had greater number of primary rugae on right and left sides in contrast to the Mongoloids as well as the overall Nepalese population as outlined by other study [13]. Number of secondary rugae is somewhat close in both ethnic groups. The finding is similar to other studies done in Nepalese population [13,14].

The circular pattern was very rare in our study groups. This is in line with the study in Igbo and Ikwerre ethnicities in Nigeria [15].

Straight type of rugae was most prevalent in Tharus, whereas curved pattern dominated the Mongoloid sample. The studies conducted in Nepal found wavy to be predominant pattern [14]. In a comparative study done in India, the finding was in agreement with present study (Mongoloids sample) with straight pattern dominating both Indian and Nepalese population [13]. This can be due to shared ethnic distribution in Nepal and India. Another reason could be cross-border marriage between Nepalese and Indians.

Tharus in our study sample were found to be possessing higher number of curved pattern followed by straight and wavy in contrast to Mongoloids, who possess straighter pattern followed by curved and wavy. Thus both ethnicities had the least number of wavy types of rugae. Wavy pattern was found to be predominant and straight was rare occurrence in Nigerian population [16] as well as in Tibetan population [17] in contrast to our results. This would suggest that there exist substantial difference in number of rugae type in different races in the world.

In agreement with the finding in Mogoloids, the straight pattern was also predominant in West Godavari population in India. The mean number of primary rugae was, however, higher than that of both ethnic groups in current study (7.48 in males and 6.94 in females) [18]. This was also evident in another study in Indian population where mean number of primary rugae (7.70 in male, 7.71 in female) was higher than our study [19]. The result of this study showed clear demarcation between the studied samples. And it can be thus utilized for identification purpose in many instances where other things fail.

Conclusion

Palatal rugae pattern is considered to be unique to an individual and their use in forensic identification has been advocated and applied. The rugae are also considered to have population-specific configuration. The palatal rugae shape characteristics in two populations from eastern Nepal have been studied. Significant differences between the two populations were observed in straight and curved rugae, the difference might be attributed to genetic factors. We recognize that the above interpretations are precluded by limited sample size and, therefore, the preceding analysis should only be considered as preliminary. Nevertheless, we believe that rugae shape have great utility in population differentiation and should be examined in detail in large samples to further validate our findings.

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