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Differences in the palatal rugae shape in two populations of India☆

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ABSTRACT

Objectives: The aim of the study was to investigate differences in the shape of the palatal rugae in two populations of India and develop discriminant function to identify the populations based on rugae shape.

Methods: Thirty plaster casts from each population group, equally distributed between the sexes and belonging to similar age-group, were examined for rugae shape (straight, wavy, curved, unification and circular) and their incidence recorded. Association between rugae shape and population as well as rugae shape and sex were tested using chi-square analysis and discriminant function developed using SPSS 10.0 statistical package.

Results: Wavy and curved were the most prevalent rugae shape in both groups, followed by straight rugae. Unifications were few in number while circular rugae were not observed. Chi-square analysis for association between rugae shape and population groups showed significant differences in straight and curved forms. No significant sex differences were observed. Three rugae shapes – straight, wavy and curved – contributed to the discriminant function which enabled population identification with an accuracy of 70%.

Conclusions: Palatal rugae shape revealed significant differences between the two Indian populations and also confirmed previous reports of lack of sex dimorphism. Discriminant function analysis allowed moderate differentiation of the populations and it is inferred that discrete variables such as rugae shape are better suited for the purpose than continuous variables such as rugae length. However, these interpretations are precluded by the small sample size and further work on larger samples is required to validate the findings.

1. 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 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

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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] Racial profiling using intra-oral features other than the teeth may have relevance in odonto-stomatological identification in India where, credible dental anthropological data is negligible. Therefore, the present study has ventured to examine palatal rugae shape in a limited sample of Indians, with the objectives of providing preliminary data on (1) possible differences in rugae shape between two population groups of India, and (2) the effectiveness of rugae shape in identifying the populations using discriminant function analysis.

2. Materials and methods

The sample comprised of two heterogeneous linguistic groups from geographically different regions of India—Karnataka state in the south and Gujarat state in the west. While not entirely representative of their respective regions, the two populations will henceforth be referred to as ''Southern Indians'' and ''Western Indians.'' The sample included 30 plaster casts from each group, equally distributed between the sexes. Considering the lack of consensus on rugae stability with respect to ageing,[5–8] the study casts were derived from individuals within a narrow age-range (18–23 years). All participants were undergraduate dental students enrolled in our institution and plaster casts were obtained following informed verbal consent. The rugae were delineated using a sharp graphite pencil under adequate light and magnification,[12] and recorded according to the classification given by Kapali et al.[6] Rugae were categorised as 'straight,' 'wavy,' 'curved' and 'circular' (Fig. 1(a) and (b)). In addition, if a ruga had two arms, it was categorised as 'unification.' Thomas and Kotze[13] have categorised two-armed rugae as 'branches' or 'unification' depending on the length of their origin; unifications have further been classified as converging or diverging, depending on the type of origin.[6] The present study has, however, categorised all forms of unified and branched rugae – irrespective of length and origin – as 'unification.' Moreover, all rugae were considered for the study, irrespective of their length (e.g. some authors[5,6] have only considered rugae $\geq$5 mm). Rugae observations were repeated on a set of 14 randomly selected casts to test for possible intra-observer variation. Association between rugae shape and ethnicity as well as rugae shape and sex were tested using chi-square analysis and a step-wise discriminant function developed using the SPSS 10.0 statistical package (SPSS Inc., Chicago, Illinois, U.S.A.). The discriminant analysis used in this study is a parametric procedure, not optimal for multivariate analysis of discrete variables such as rugae shape. A non-parametric discriminant procedure would have been ideal. However, this could not be explored due to its unavailability in the statistical tools at our disposal.

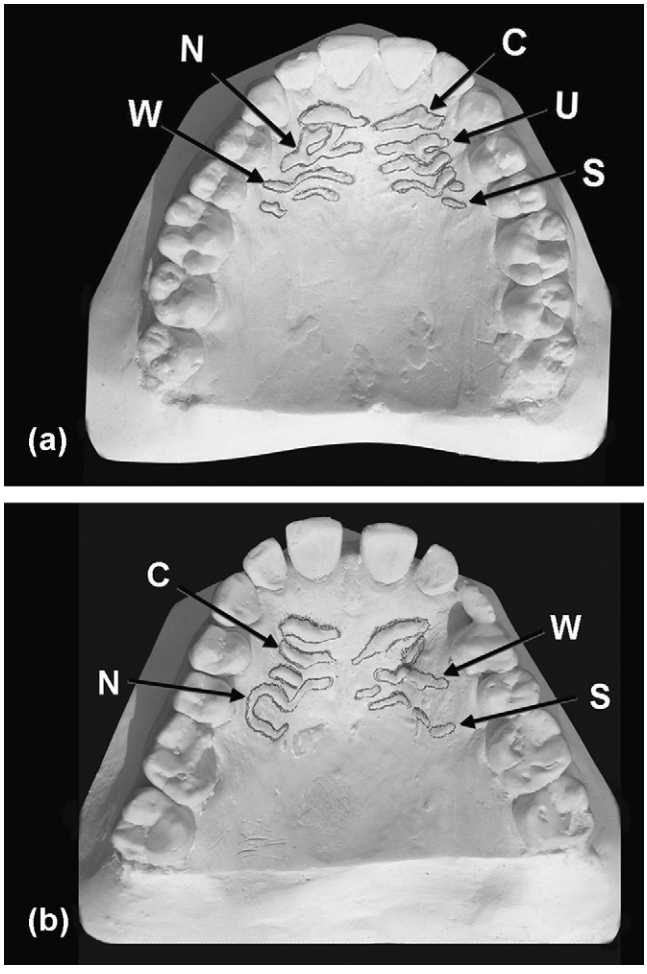

Fig. 1 – Different types of palatal rugae shape delineated in two maxillary dental casts (a and b). Straight (S), wavy (W) and curved rugae (C) were the most prevalent forms in the two populations. Unifications (U) were less common while no circular rugae could be appreciated. Additional, non-specific rugae pattern (N), were observed in a few casts.

3. Results

The incidence of different rugae shapes in the two populations is described in Table 1. Wavy and curved rugae were the most prevalent forms in both groups, followed by straight rugae. Unifications constituted less than 5% of rugae in the entire sample of 60 casts while circular rugae were absent. A few non-specific rugae forms were observed (Fig. 1(a) and (b)). However, in view of the limited sample size, they were not subjected to statistical analyses. No significant intra-observer variation could be ascertained for the different rugae shapes (Table 2). Chi-square analysis for association between rugae shape and population groups showed significant differences in straight and curved forms at the $p \leq 0.05$ level (Table 3). The former were more in number in Southern Indians while the latter in Western Indians. No significant sex differences ($p \leq 0.05$) in rugae shape were observed within each population and, therefore, data by sex was combined for both populations. The combined data is presented in Table 4 and also revealed no significant male–female differences ($p \leq 0.05$)—observations that are consistent with previous reports.[6,12,14]