

Types of Palatal Rugae for Sex Determination in the Indonesian Subpopulation

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Abstract

Palatal rugae patterns are considered unique to each person and are, therefore, comparable to fingerprints. Palatal rugae are stable over the lifetime and do not undergo any changes, except for the increase in length as a process of normal growth. The present study aimed to analyze the patterns of palatal rugae in an Indonesian subpopulation for sex determination. The study included 100 samples (53 females and 47 males) of dental casts from 13–75-year-old subjects. The patterns of the rugae on the right and left sides of the palate were examined. The dental casts were examined for the total number of rugae using Lysell's classification. Based on the results of the Mann–Whitney test, no significant differences in the numbers of primary, secondary or fragmentary palatal rugae were observed between the female and male subjects in the tested Indonesian subpopulation. The number of palatal rugae cannot be used for sex determination in the tested Indonesian subpopulation.

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Introduction

Human identification is one of the major areas of interest and research among the various fields in forensic science. It involves the identification of human remains or cadavers by observing the individual characteristics that can differentiate a specific individual from others. Unfortunately, in cases like mass disasters, traffic accidents or acts of terrorism, the identification of a single person can prove to be a challenging task.¹

Forensic odontology is a specific field in dentistry, which has been used for medico-legal identification.² The most commonly used scientific and reliable methods of forensic identification are DNA, fingerprints, and dental records. However, these methods are not applicable in some cases such as in edentulous patients due to the absence of teeth or in victims with burned or severely decomposed bodies, where there the fingerprints cannot be

examined.^{3, 4}

Palatal rugae are asymmetric and irregular ridges located on the palate behind the incisive papilla and spread on to the right and left sides of the mid-sagittal plane. They are involved in the processes of chewing, swallowing, and taste perception due to the presence of gustatory and tactile receptors.⁵ Embryologically, the palatal rugae are formed from the covering connective tissue in the palatal process of the maxillary bone during the third month of intrauterine life.⁶ The study of palatal rugae with the intention to establish the identity of an individual is called palatal rugoscopy or palatoscopy. Palatoscopy has gained importance in forensic odontology over the past decade.⁷

The genetic basis of the morphology of human palatal rugae mediates individual-specific features that remain unchanged in an individual's lifetime. Because of its position in the oral cavity, palatal rugae are protected against trauma, high temperatures, and decomposition by the lips, cheek, tongue, skeleton, and teeth.⁸ Palatal rugae are somewhat comparable to fingerprints and are unique to individuals.⁹ The reasons for the use of palatal rugae as an alternative method for postmortem identification include individuality, postmortem resistance, and stability.¹⁰

Tooth loss or eruption will not affect the layout and characteristics of the palatal rugae,

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although the positions of the rugae near the alveolar arch may be altered after tooth extraction in some cases.¹¹ A study has stated that the palatal rugae are not alike in their configurations, even in twins¹² Once formed, they only change in length during the normal growth process and remain in the same position throughout life.¹³

The aim of this study was to analyze various types of rugae in an Indonesian subpopulation and evaluate its usefulness for sex determination.

Methods

One hundred plaster casts from 53 female and 47 male Indonesian subjects aged 13 to 75 years old were used in the study. Ethical permission for the study was obtained from. The initial preparation was conducted by taking an impression from the maxillary arch using alginate, followed by the preparation of the diagnostic cast using dental stone. A sharp graphite pencil was used to depict the rugae on the study model based on the Lysell classification¹⁴ under adequate light conditions. According to this classification, the rugae are divided into three categories: primary rugae, which are more than 5 mm in length; secondary rugae, which are 3 to 5 mm in length; and fragmentary rugae which range from 2 to 3 mm in length. Rugae smaller than 2 mm were disregarded in this study.

The measurements were made directly from the casts using a steel ruler with 1 mm scaling. The rugae were measured in a straight line from the point of origin to the point of termination. The casts chosen for measurement were free from air bubbles or voids, particularly in the anterior part of the palate. The casts were obtained from individuals who did not receive any orthodontic treatment, had a symmetrical palate, and were not diagnosed with any congenital abnormalities, trauma, inflammation or malocclusions.

The data were statistically analyzed using SPSS, version 16.0. The number of palatal rugae was analyzed using Mann–Whitney test because the distribution of the data was not normal.

Results

As shown in Table 1, the mode value of the primary rugae in males (7) was slightly higher than that in females (6), but the difference was not statistically significant ($P > 0.05$). The mode

value of the secondary and fragmentary rugae in both males and females was 0. Likewise, no significant differences in the mode values of all rugae types were noted between the males and females.

Types of palatal rugae	N	Female (53)			Male (47)			P-value
		Mode	Min.	Max.	Mode	Min.	Max.	
Primary	100	6	1	10	7	3	11	0.273
Secondary	100	0	0	7	0	0	6	0.573
Fragmentary	100	0	0	4	0	0	4	0.629
All types	100	10	3	15	10	4	18	0.402

Table 1. Types of Palatal Rugae in Females and Males.

Types of palatal rugae	Sex	Right Palate			P-value	Left Palate			P-value
		Mode	Min.	Max.		Mode	Min.	Max.	
Primary rugae	M	3	1	7	0.527	3	1	5	0.238
	F	3	1	6		4	0	6	
Secondary rugae	M	0	0	5	0.479	0	0	4	0.486
	F	0	0	5		0	0	2	
Fragmentary rugae	M	0	0	2	0.199	0	0	3	0.248
	F	0	0	2		0	0	3	
All types of rugae	M	3	1	8	0.321	4	2	8	0.834
	F	4	2	9		4	2	10	

Table 2. Palatal Rugae on the Right and Left Palates in Females and Males.

As seen in Table 2, the mode values of the primary rugae in the right palate in males and females were the same (3). The mode value of the primary rugae in the left palate in females (4) was slightly higher than that in males (3), statistical significance notwithstanding. The mode values of the secondary and fragmentary rugae in the left and right palates in females and males were the same (0). The mode values of all rugae types in the right palate were slightly higher in females (4) compared to those in males (3), statistical significance notwithstanding. The mode values of all rugae types in the left palate were the same (4) in the males and females.

Discussion

The use of DNA, dental records, and fingerprints is associated with certain limitations in some cases; therefore, palatal rugae patterns may be considered as an alternative method for identification. The present study was performed to study the rugae patterns and to compare the types of rugae between males and females in a tested Indonesian subpopulation for potential sex determination.

Based on the research conducted by English et al.¹⁵ and Peavy and Kendrick et al.¹¹, the characteristic patterns of the palatal rugae remain stable throughout the entire lifetime, until degeneration of the oral mucosa takes place after death. This includes the normal growth and development of the individual as well as the palate structure. However, some events may change the pattern, such as finger sucking in children, trauma, and persistent pressure as a result of orthodontic treatment and the use of dentures.¹⁶ The length of the rugae may change with age due to the underlying palatal growth. Nonetheless, according to Van Der Linden,⁹ the length does not increase after 10 years.

In this study, the primary rugae was most commonly observed, and no significant difference between the genders was noted. This finding is consistent with that reported by Bajracharya et al.¹⁷ in a Nepalese population, Kapali et al.⁹ among Australian aborigines and, Shetty et al.¹⁸ in the Indian population. The results of the present study were contrary to those of Madhankumar et al.,¹⁹ who reported a significant difference in the number of primary rugae between the genders among a group of Indians. In this study, the differences in the types of rugae between males and females were not significant. Similar findings have been reported by Kamala et al.²⁰ and Saraf et al.² Therefore, the use of palatal rugae is unlikely to be useful as a method of gender identification.

Conclusion

The numbers of primary, secondary or fragmentary palatal rugae, as assessed according to Lysell's classification, were not significantly different between the male and female subjects in the tested Indonesian subpopulation. Thus, it can be concluded that the number of palatal rugae cannot be used for sex determination.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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