

Palatoscopy and Palatal Rugae Pattern among Adolescents of Southeastern Kosovo

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Abstract

Background: Palatal rugae are elevations found on the anterior part of the hard palate and are the most stable features in the mouth. Our study aimed to analyze the palatal rugae pattern among an adolescent sample of the Albanian population in southeastern Kosovo.

Methods and Results: A total of 100 adolescents (50 females and 50 males) aged from 12 to 18 were selected from schools in southeastern Kosovo. Palatal impressions were taken with elastomers, and models of the upper jaw were poured into stone casts for further examination. The rugae patterns were classified according to the Thomas and Kotze classification. The current study indicates that the predominant rugae pattern among the young population in southeastern Kosovo is the straight rugae. The predominant rugae pattern among female subjects is straight rugae and among males, wavy rugae; the frequency of various rugae patterns differed significantly between men and women. The total number of palatal rugae in men was significantly higher than in women. At the same time, there is no significant difference in the number of palatal rugae on the left and right sides between male and female subjects. (**International Journal of Biomedicine. 2024;14(2):319-323.**)

Keywords: palatoscopy • palatal rugae • rugae pattern

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Introduction

Palatoscopy, or palatal rugoscopy, studies palatal rugae patterns. Palatal rugae become apparent in the mouth between the 12th and 14th weeks of prenatal life. Epithelial-mesenchymal interactions are known to play a critical role in the development of many organs, including the palate. Periodic patterning of iterative structures, the palatal rugae, develops by Turing-type reaction-diffusion mechanisms that occur through epithelial-mesenchymal interactions.⁽¹⁾ Physiologically, relieving the palate helps swallowing, speech, tasting food, and sucking of the finger in children.⁽²⁾

Palatal rugae, like fingerprints, do not change throughout life. No two palates are alike regarding their rugae pattern, which remains stable even during an eruption or tooth loss.⁽³⁾ The most widely known classification is the Thomas and Kotze classification.⁽⁴⁾ Palatoscopy is also an important tool for gender determination.^(5,6) Every person has a unique palatal rugae pattern, even in monozygotic twins. Herrera et al.⁽⁷⁾ showed that palatal rugae were unique to each individual, even in monozygotic twins. Lestari et al.,⁽⁸⁾ in their study of monozygotic twins, concluded that patterns of palatal rugae were unique in identical twins even though they showed a mirror-image effect. Therefore, they could be used as an adjunctive tool for medico-legal identification.

Currently, palatoscopy is considered a promising alternative method for identifying human individuals. Palatoscopy doesn't need complex instrumentation for examination but requires a very well-trained dentist with broad background knowledge in forensics. Mahajan et al.,⁽⁹⁾ analyzing many studies in their review article, concluded that

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palatoscopy can be successfully used for identifying humans. When dental identification is not possible in an edentulous patient, palatoscopy is the method of choice.⁽¹⁰⁾ Poojya et al.⁽¹¹⁾ concluded that cast records are beneficial in these cases, but if they are unavailable, the mucosal surface of the dentures could be a good source for taking records. Our study aimed to analyze the palatal rugae pattern among an adolescent sample of the Albanian population in southeastern Kosovo.

Materials and Methods

A total of 100 adolescents (50 females and 50 males) aged from 12 to 18 were selected from schools in southeastern Kosovo. All 100 subjects were healthy, without any congenital abnormalities, orthognathic operations, previous orthodontic treatment, inflammation, trauma, malformations, deformities, or surgical scars.

Materials used for the study were elastomers (Zhermack), graphite pencils, and scissors (Figure 1). Palatal impressions were taken with elastomers, and models of the upper jaw were poured into stone casts for further examination. The shape of the rugae was traced with a graphite pencil (Figure 2).



Fig. 1. Materials used for data collection.



Fig. 2. The highlighted rugae with graphite pencil.

According to the Thomas and Kotze classification, the rugae patterns were classified based on shape, unification, and length. Based on shape, rugae were divided into Wavy (curved

shape at the origin or termination), Straight (the rugae run directly from the origin to termination), Circular (rugae that form a continuous ring), Curved (crescent and curved gently); unification was defined as when two rugae are joined at their origin or termination. Unification was classified into divergent (rugae were considered to be diverging if two rugae had the same origin but immediately branched) and convergent (rugae were considered to be converging if two rugae with different origins joined on their lateral portions). The rugae were also classified based on their length as primary rugae (>5 mm), secondary (3-5 mm), and fragmentary (<3 mm).

Statistical analysis was performed using statistical software package SPSS version 23.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages for categorical variables. Differences in attributive series between the patient groups were tested using Pearson Chi-square / Monte Carlo Sig. (2-sided). In all cases, a probability value of $P < 0.05$ was considered statistically significant.

Results

Table 1 and Figure 3 show the shapes of the palatal rugae pattern in the subjects included in the study. A total of 519 palatal rugae pattern were registered in 50 female subjects: 277(53.37%) on the right and 242(46.63%) on the left side. A total of 592 palatal rugae pattern were registered in 50 male subjects: 294(49.66%) on the right and 298(50.34%) on the left side. On the right side of the palates of female subjects, the straight rugae were dominant (98/35.38%), followed by wavy rugae (68/24.55%), curved rugae (41/14.80%), circular rugae (30/10.83%), divergent rugae (29/10.47%), and convergent rugae (11/3.97%). The distribution pattern of different variants of rugae shapes on the left side of the palates of female subjects was similar to that on the right side. On the right side of the palates of male subjects, the wavy rugae were dominant (87/29.59%), followed by straight rugae (75/25.51%), curved rugae (57/19.39%), circular rugae (42/14.29%), divergent rugae (18/6.12%), and convergent rugae (15/5.10%). The distribution pattern of different variants of rugae shapes on the left side of the palates of male subjects was similar to that on the right side.

Table 1.
Shapes of the palatal rugae pattern in the study subjects.

Variable	Valid N	Female	%	Valid N	Male	%
Straight/Right	50	98	35.38	50	75	25.51
Straight/Left	50	68	28.10	50	80	26.85
Wavy/Right	50	68	24.55	50	87	29.59
Wavy/Left	50	67	27.69	50	76	25.50
Curved/Right	50	41	14.80	50	57	19.39
Curved/Left	50	50	20.66	50	68	22.82
Circular/Right	50	30	10.83	50	42	14.29
Circular/Left	50	24	9.92	50	42	14.09
Divergent/Right	50	29	10.47	50	18	6.12
Divergent/Left	50	23	9.50	50	20	6.71
Convergent/Right	50	11	3.97	50	15	5.10
Convergent/Left	50	10	4.13	50	12	4.03

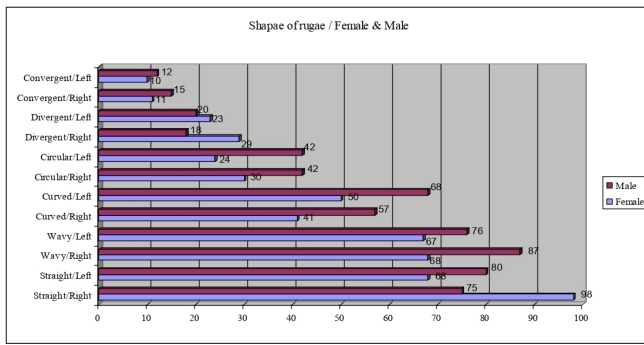


Fig. 3. Shapes of the palatal rugae pattern in the subjects included in the study.

Thus, among all those examined, 1111 palatal rugae were registered: the straight rugae (321/28.89%) were dominant, followed by wavy rugae (298/26.82%), curved rugae (216/19.44%), circular rugae (138/12.42%), divergent rugae (90/8.1%), and convergent rugae (48/4.32%) (Table 2 and Figure 4). The total distribution of the rugae patterns in female and male subjects is presented in Table 2. We found a significant difference in the total number of palatal rugae between female and male subjects (Pearson chi-squared =13.07 and P=0.023 / Monte Carlo Sig. (2-sided) / 0.019–0.026 /) (Table 2 and Figure 4). The frequency of various rugae patterns also differed significantly between men and women.

Table 2. Total distribution of the rugae patterns in female and male subjects.

			Shape of rugae						Total
			Straight	Wavy	Curved	Cir	Div	Con	
Gender	Female	Count	166	135	91	54	52	21	519
		%	32.0	26.0	17.5	10.4	10.0	4.0	100.0
	Male	Count	155	163	125	84	38	27	592
		%	26.2	27.5	21.1	14.2	6.4	4.6	100.0
Total		Count	321	298	216	138	90	48	1111
		%	28.9	26.8	19.4	12.4	8.1	4.3	100.0

Cir - Circular; Div - Divergent; Con - Convergent.

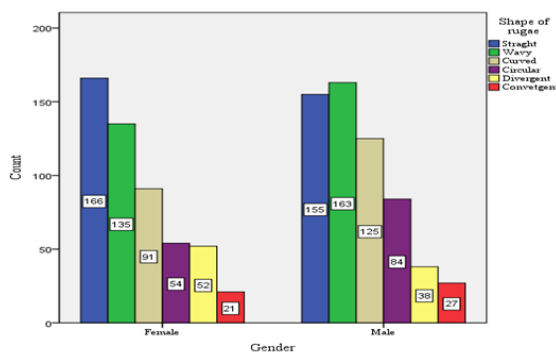


Fig. 4. Total distribution of the rugae patterns in female and male subjects.

Tables 3-4 and Figures 5-6 show the palatal rugae distribution based on their length on the right and left sides in female and male subjects.

In female subjects, on the right side, primary rugae were found in 197(69.12%) women, secondary rugae in 47(16.49%), and fragmentary rugae in 41(14.39%). The distribution patterns of primary, secondary, and fragmentary rugae on the left side of the palate were as follows: primary rugae - 193(72.83%), secondary rugae - 32(12.08%), and fragmentary rugae - 40(15.09%).

Table 3. Palatal rugae distribution based on their length on the right and left sides in female subjects.

Gender	Side	n	Primary Rugae 5-10 mm	%	Secondary Rugae 3-5 mm	%	Fragmentary Rugae <3 mm	%	Total
Female	Right	50	197	69.12	47	16.49	41	14.39	285
	Left	50	193	72.83	32	12.08	40	15.09	265
Total		100	390		79		81		550

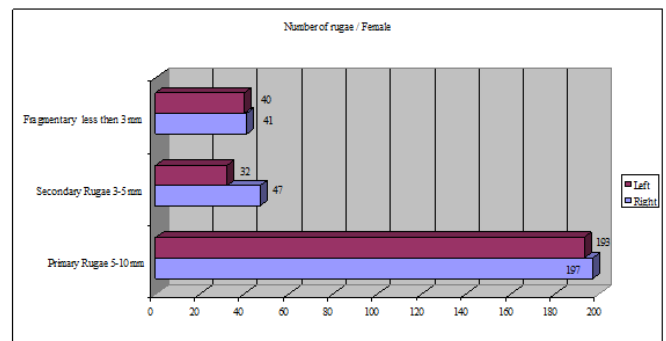


Fig. 5. Palatal rugae distribution based on their length on the right and left sides in female subjects.

Table 4. Palatal rugae distribution based on their length on the right and left sides in male subjects.

Gender	Side	n	Primary Rugae 5-10 mm	%	Secondary Rugae 3-5 mm	%	Fragmentary Rugae <3 mm	%	Total
Male	Right	50	200	70.18	42	14.73	43	15.09	285
	Left	50	200	69.20	46	15.92	43	14.88	289
Total		100	400		88		86		574

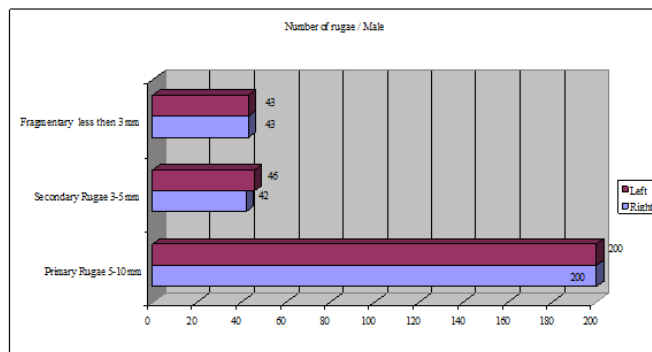


Fig. 6. Palatal rugae distribution based on their length on the right and left sides in male subjects.

In male subjects, on the right side, primary rugae were found in 200(70.18%) men, fragmentary rugae in 43(15.09%), and secondary rugae in 42(14.73%). The distribution patterns of primary, secondary, and fragmentary rugae on the left side of the palate were as follows: primary rugae - 200(69.20%), secondary rugae - 46(15.92%), and fragmentary rugae - 43(14.88%).

We found no significant difference in the number of primary, secondary, and fragmentary palatine rugae on the right and left sides of female and male subjects ($P=0.34$ and $P=0.93$, respectively).

Discussion

Palatoscopy studies palatal rugae, which are characteristic elevations in the anterior part of the hard palate. They are also unique for every person, like fingerprints. In the present study, 1111 palatal rugae were found in the study sample. The predominant rugae, among all subjects, were straight rugae (28.89%), followed by wavy shape (26.82%), curved rugae (19.44%), circular rugae (12.42%), divergent rugae (8.1%), and convergent rugae with the lowest frequency (4.32%). Similar results have been shown in studies by Pillai et al.,⁽¹²⁾ Khalid et al.,⁽¹³⁾ and Sheikhi et al.,⁽¹⁴⁾ where the most common rugae were the straight type, followed by the wavy type. In contrast, a study by Byatnal et al.⁽¹⁵⁾ found that a wavy shape was predominant among five different populations of India. Our study showed that the predominant rugae pattern in females was straight rugae (32%), while the wavy type was predominant in males (27.5%). The total number of palatal rugae in men was significantly greater than in women. The results of a study by Sharma et al.⁽¹⁶⁾ showed contradictory data. We found no significant difference in the number of primary, secondary, and fragmentary palatine rugae on the right and left sides of female and male subjects. These findings were consistent with a study by Jadoon et al.⁽¹⁷⁾

Conclusion

The results of the current study indicate that the predominant rugae pattern among the young population in southeastern Kosovo is the straight rugae. The predominant

rugae pattern among female subjects is straight rugae and among males, wavy rugae; the frequency of various rugae patterns differed significantly between men and women. The total number of palatal rugae in men was significantly higher than in women. At the same time, there is no significant difference in the number of palatal rugae on the left and right sides between male and female subjects.

Ethical Considerations

Ethical approval for this study was obtained from the Ethical Committees of the Faculty of Dentistry of Ss. Cyril and Methodius University in Skopje (N#02-150115) and the Dental Chamber of Kosovo, Republic of Kosovo (N#19). All participants provided written informed consent.

Competing Interests

The authors declare that they have no competing interests.

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