

ASSESSMENT OF PALATOSCOPY AND ODONTOMETRY IN STOMATOLOGY

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Abstract: Palatal rugae and teeth are genetically determined. Palatal rugae are unique mucosal elevations seen on the anterior third palate. They are the most stable characteristics in the oral cavity. They can be used to evaluate the changes in teeth positions during orthodontic treatment. Also, palatal rugae can be used for human identification, in differentiation of population and gender determination.

Teeth are part of masticatory apparatus, the hardest tissue on the body, but chemically the most stable and durable even at high temperatures. Among the teeth canines shows the greater resistance to pathological alteration and trauma. Canines among all teeth have shown the greatest sexual dimorphism and moreover are least affected by caries and periodontal disease these attributes to make them reliable to be used to check sexual dimorphism.

The aim of the study is to establish identity of population using palatoscopy and odontometry.

Materials and methods: The present study involves 35 subjects between 12-16 years old. Palatal impressions are taken with alginate hydrocolloid and models are poured in dental cast of stone.

Results: The data analysis was performed in a statistical program Statistica 7.1 for Windows and SPSS 23.0. Significance is determined by $p < 0.05$. The data are presented in tabular form.

The predominant rugae pattern in female was Straight rugae, in males Wavy rugae pattern also the predominant rugae pattern in Class I according to Angle was Wavy in males, Straight type in females same as in Class II Angle classification, Wavy type in male and Straight type in females

The mesiodistal width of right canine at females is larger than left canine. The mesiodistal width of left canine is larger than the mesiodistal width of canine on the right side. The mandibular intercanin width in male subjects is slightly higher than the corresponding value in female. All measurements in male were slightly higher than in female subjects.

Conclusion: In our study, palatoscopy revealed strong association with ethnicity, gender also with sagittal skeletal jaw relation, thus predicting malocclusions that could be managed early with preventive and interceptive orthodontics. Also odontometric measurements mesiodistal width and mandibular intercanin width serve as a good tool in gender determination and should be used as additionally method in sex determination.

Keywords: Palatoscopy, Odontometry, Forensic medicine

1. INTRODUCTION

Palatal rugae are unique structures, well formed, asymmetrical, irregular mucosal folds presented in the anterior part of the hard palate also called "plicae palatinae" (Syed et al., 2016) They develop by approximately 12th to 14th week of prenatal life by a Turing – type reaction – diffusion mechanism, where SHh plays as an inhibitor factor and Fgf as an activator factor for sending signals for appropriate organization of these structures (Kawasaki et al., 2018). Palatoscopy studies anatomy of palatal rugae in order to establish person's identity (Dwivedi et al., 2013), Palatal rugae like fingerprints, do not change during the life, they are well protected from trauma, injuries and high temperature due to the internal position in the oral cavity. Nor two plates are alike in terms of their rugae pattern, including non-identical twins (Indira et al., 2012). The pattern of rugae remains stable even during eruption or loss of teeth. Some changes do occur in the rugae during orthodontic treatment, but the morphology of palatal rugae remains stable through tout life. Also they are the most reliable points which remain stable are medial and lateral third rugae points, which could be used to evaluate dental movements in orthodontics (Shukla et al., 2011). After maxillary expansion the separation of palatal could be quantified using inter – rugae distance (Shailaja et al., 2018). From that point of view, palatoscopy is an important tool for gender identification but some researchers showed the opposite.

Teeth are part of masticatory apparatus, the hardest tissue on the body, but chemically the most stable and durable even at high temperatures. Among the teeth canines shows the greater resistance to pathological alteration and trauma (Kapila et al., 2011).

Canines among all teeth have shown the greatest sexual dimorphisms and moreover are least affected by caries and periodontal disease these attributes to make them reliable to be used to check sexual dimorphism. In identification of people sometimes is necessary to apply different and less known techniques. Palatoscopy and odontometry are two simple, reliable, cost – effective, noninvasive techniques that can be used successfully in human identification (Caldas et al., 2007)

2. THE PURPOSE OF THIS STUDY

The purpose of the study is to establish identity of population using palatoscopy and odontometry. Also envisaging the application of these methods in identification of people, sex discrimination, and correlation between these parameters and dental malocclusions. The objectives of the study are:

1. To evaluate the quantitative and qualitative parameters of palatal rugae and assess the predominant rugae pattern. To evaluate predominant rugae pattern among class I, II, III malocclusion groups according to Angle's classification and explore the possibility of utilizing it in predicting these malocclusions. To assess the morphology gender difference of rugae pattern between males and females.
2. To assess sexual dimorphism using odontometric measurements in right and left permanent mandibular canine.

3. MATERIAL AND METHODS

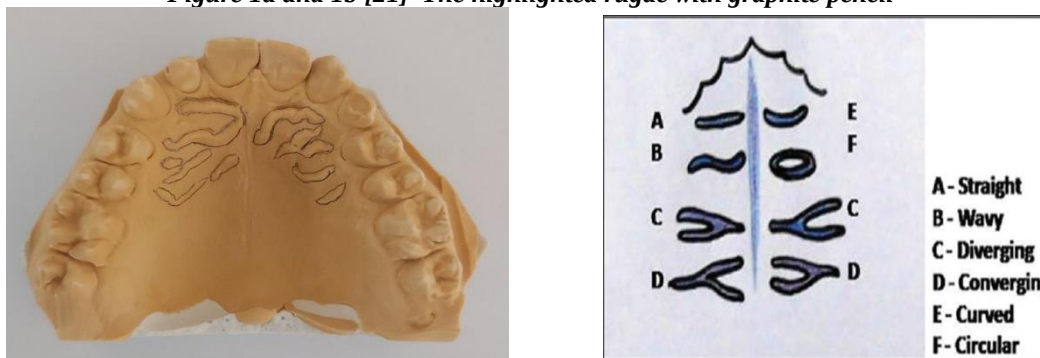
Present study involved 35 adolescents of South East of Kosovo selected among schools between 12-16 year old, 19 female and 16 male. All participants are well informed for the purpose of the study and signed an informed consent prepared before the examination. Palatal impressions and dental impressions are taken with elastomers, C Silicone and models of upper jaw and lower jaw will be poured in dental cast of stone. Odontometrics is done with digital Vernier caliper. From every participant, palatal impressions and odontometrics are recorded on the same day.

Criteria of selection: All participants should be healthy, without any congenital abnormalities, without orthognatic surgeries, without previous orthodontic treatment, without inflammation, trauma, malformation, deformity, and caries free canines.

Materials Materials that are being used are: C Silicone impression material (Zhermack), White paper A4 size white paper, Graphite pencil (AIHAO 0.7 mm), Digital Vernier Caliper, Magnifying lense,

Methodology For palatoscopy: The shape of the rugae are traced with graphite pencil under adequate light. Rugae pattern will be classified according to Thomas and Kotze's Classification (Thomas & Kotze , 1983) (Fig. 1a ,1b)

Figure 1a and 1b [21] The highlighted rugae with graphite pencil



For odontometric analyses: Measurements are done with digital Vernier caliper on the dental casts.

Results In the present study (19 female and 16 male subjects) was found that predominant rugae pattern in female was Straight rugae, in males Wavy rugae pattern.

Table 1: Predominant rugae shape among females and males

Shape of rugae	Straight	Wavy	Curved	Circular	Divergent	Convergent
Female	30	28	20	5	7	3
Percentage	32.2%	30.1%	21.5%	5.37%	7.52%	3.22%
Male	18	36	9	7	3	/
Percentage	24.65 %	49.3%	12.3%	9.58%	4.1%	/

Rugae pattern among classes according to Angle classification

The predominant rugae pattern in Class I according to Angle was Wavy type in males Straight type in females, also in Class II Angle classification was found Wavy type in male and Straight type in females.

CLASS I – Predictive gender values

Table 2.1: Predictive gender values of the respondents for Class I malocclusion / Model of discrimination

Observed			Predicted		
			Class I		Percentage Correct
			No	Yes	
Step 1	Class I	No	23	0	100,0
		Yes	12	0	,0
	Overall Percentage				65,7

a. The cut value is ,500

Female subjects (Gender (1) by 1,283 times (Exp (B) = 1,283) have a slightly higher risk of malocclusion Class I / 95% CI: 0.314-5,253 / $p > 0.05$ compared to male subjects (Table 3.2).

Table 2.2: Binary Logistic Regression Analysis for Prediction of malocclusion Class I / Gender

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 ^a	Gender (1)	,249	,719	,120	1	,729	1,283	,314	5,253
	Constant	,788	,539	2,137	1	,144	,455		

a. Variable(s) entered on step 1: Gender.

CLASS II- Predictive gender values

Table 3.1: Predictive gender values of Class II malocclusion respondents /Discrimination model

Observed			Predicted		
			Class II		Percentage Correct
			No	Yes	
Step 1	Class II	No	10	6	62,5
		Yes	9	10	52,6
	Overall Percentage				65,7

a. The cut value is ,500

Female subjects (Gender (1) by 0.540 times (Exp (B) = 0.540) have a slightly lower risk of class II malocclusion / 95% CI: 0.139-2.093 / $p > 0.05$ compared to male subjects (Table 4.2).

Table 3.2: Binary Logistic Regression Analysis for Prediction of malocclusion Class II / Gender

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 ^a	Gender (1)	,616	,691	,795	1	,373	,540	,139	2,093
	Constant	,511	,516	,979	1	,323	1,667		

a. Variable(s) entered on step 1: Gender.

Number of rugae

Table 4: Number of rugae / Female & Male

			Primary Rugae 5-10 mm	Secondary Rugae 3-5 mm	Fragmentary less than 3 mm
Gender	Side	Valid N	Sum	Sum	Sum
Female	Right	19	69	22	21
Female	Left	19	72	17	26
Male	Right	16	69	7	10
Male	Left	16	70	13	11

For Pearson Chi-Square = 1.20 and $p > 0.05$ ($p = 0.59$) in female between the right and left side there is no significant difference in the palatal number of rugae. For Pearson Chi-Square = 1.50 and $p > 0.05$ ($p = 0.47$) in male there is no significant difference between the right and left number of palatal rugae.

2. The mandibular canin width (MDW) & The mandibular inter canin width (ICW)

Female: The results shown in table 5 and 5.1 refer to the width of the mandibular canine (MDW) on the right and left, as well as the mandibular width (width of the arch) between the two canines (ICW) in female subjects.

Table 5: The mandibular canin width (MDW) & The mandibular inter canin width (ICW) / Female

Variable	Valid N	Mean	Minimum	Maximum	Std. Dev.
MDW / Right	19	6,69	6,00	7,50	0,50
MDW / Left	19	6,59	6,00	7,50	0,48
ICW	19	24,95	21,00	28,00	1,92

Table 5.1: The mandibular canin width (MDW) / Female / Right & Left

Variable	Rank Sum Right	Rank Sum Left	U	Z	p-level	Valid N	Valid N
MDW / Right & Left	388,50	352,50	162,50	0,53	0,60	19	19

The width of the mandibular canine (MDW) on the right in female subjects for $Z = 0.53$ and $p > 0.05$ ($p = 0.60$) is slightly larger than the width of the mandibular canine (MDW) on the left (table 6.1)

Male: The results shown in table 7 and 7.1. refer to the width of the mandibular canine (MDW) on the right and left, as well as the mandibular width (width of the arch) between the two canines (ICW) in male subjects.

Table 6: The mandibular canin width (MDW) & The mandibular inter canin width (ICW) / Male

Variable	Valid N	Mean	Minimum	Maximum	Std. Dev.
MDW / Right	16	6,71	6,00	7,50	0,48
MDW / Left	16	6,88	6,00	8,00	0,61
ICW	16	26,06	23,00	29,00	1,93

The width of the mandibular canine (MDW) on the left side in male subjects for $Z = -1.00$ and $p > 0.05$ ($p = 0.42$) is slightly larger than the width of the mandibular canine (MDW) on the right side (table 6.1).

Table 6.1: The mandibular canin width (MDW) / Male /Right & Left

Variable	Rank Sum Right	Rank Sum Left	U	Z	p-level	Valid N	Valid N
MDW / Right & Left	237,50	290,50	101,50	-1,00	0,32	16	16

The difference in mandibular intercanin width (ICW) between female and male subjects is shown in table 8. For $t = -1.70$ and $p > 0.05$ ($p = 0.10$) the mandibular intercanin width (ICW) in male subjects is slightly higher than the corresponding value in female subjects.

Table 7: The mandibular inter canin width (ICW) / Female & Male

Female & Male	Mean Female	Mean Male	t-value	df	p	Valid N Female	Valid N Male	Std.Dev. Female	Std.Dev. Male
ICW vs. ICW	24,95	26,06	-1,70	33	0,10	19	16	1,92	1,93

4. DISCUSSION

According to the data obtained about rugae, it was revealed that these structures are unique. Some of the studies showed that these structures differ among population, also among gender. Predominant rugae shape according the authors revealed in this article is straight rugae shape pattern. Many authors in their studies found that straight rugae pattern are the predominant pattern in both males and females (Balgi et al.,2014;Sheikhi et al.,2018). Ekrem et al.,(2017) in their study found no correlation between rugae pattern and different sagittal malocclusions. Among three groups of malocclusions, wavy and curved palatal rugae were the common types. Alshahrani, (2017), in his study concluded that numerous Wavy rugae at early childhood could be a strong predictor of sagittal class I malocclusion. Several studies found out an association between the length and number of rugae with the Angle classes of malocclusion According to a study conducted by Alshahrani, (2017) the wavy and complex shape of rugae are strong predictor for class 1and 3 malocclusions. Also the numerous Wavy rugae at childhood could be a good predictor for class I malocclusion according to Angle classification in contrast of the study conducted by Ekrem et al.,(2017) that found out that there is no significant correlation between rugae pattern and malocclusions among classes 1, 2, and 3.

In the current study malocclusions could be predicted according to gender. Female subjects have a slightly higher risk of malocclusion Class I compared to male subjects,but have a slightly lower risk of class II malocclusion compared to male subjects. During orthodontic movements Kulkarni, M. and P. Gore (2013) reveal that palatal rugae remain stable. Gadicherla et al.,(2017) in their study concluded that palatoscopy could be a method for sex determination, in contrast of the study conducted by Thabitha, (2015) that found out that there is no significant difference between males and females.

Odontometric parameters measured by several researchers showed to be significant in gender estimation, also a good tool for forensic identification of human bodies. Canines among all teeth are considered the key teeth that have shown the greatest sexual dimorphism. Genetic factors play huge role in canine size, by amelogenesis, sex linked processes. Although Ayoub et al.(2014) in their study “Mandibular canine dimorphism in establishing sex identity in the Lebanese population” concluded that odontometric parameters like width of canine and intercanine distance, measured in one hundred and thirty three Lebanese student showed statistically significant in identification of gender. These two parameters were greater in males than females similar with the present study.

In the present study the mesiodistal (MDW) width of right canine at females is larger than left canine, in contrast to males where the mesiodistal width of left canine is larger than the MDW of canine on the right side. The mandibular intercanin width (ICW) in male subjects is slightly higher than the corresponding value in female. All measurements MDW and ICW in male are slightly higher than in female subjects. Kumawat et al. (2017) in their study investigated MCI (mandibular canine index) and mesiodistal dimensions of mandibular canine with 300 evolved individuals, of central Indian population, and results from the obtained study were: Standard MCI of the right canine was 0.240 and Standard MCI of the left canine was 0.240, thus patients with MCI greater than 0.240 were females and patients with MCI less than 0.240 were males.

5. CONCLUSION

In our study, palatoscopy revealed strong association with ethnicity, gender also with sagittal skeletal jaw relation thus predicting malocclusions that could be managed early with preventive and interceptive orthodontics. Also odontometric measurements MDW and ICW serve as e good tool in gender determination and should be used as additionally method in sex determination.

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