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Original Article

The effects of gingival biotype on delayed tooth eruption in different age groups: A preliminary cross-sectional study

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Abstract

Aim: The aim of this study is to determine the relationship between gingival biotype and delayed eruption using the probe transparency technique in different age groups. The hypothesis of the present study is that the thick gingival biotype may lead to delayed eruption.
Material and Methods: A total of 131 patients (mean age, 90.21± 27.76 months), including 68 males and 63 females were included in the study. Patients were examined in 3 groups according to their dentition periods: between the ages of 3-5 years in Group 1 (G1), 6-8 years in Group 2 (G2), and 9-12 years in Group 3 (G3). Clinically, the gingival biotype was recorded by probe transparency technique. Dental age of the patients was evaluated according to Demirjian method on digital panoramic radiographs. Statistically the chi-square test was used for analysing between the gingival biotype and delayed eruption.
Results: The thick gingival biotype was observed in 88.4% and 79.1% in the maxilla and mandible in G1, respectively. In G2, thick biotype-related maxillary delayed eruption was observed in 35% of patients. In G3, the patients who have a thin gingival biotype in mandibular arch showed premature eruption.
Conclusion: Delayed eruption may be related especially in thick gingival biotype in maxillary arch.

Keywords: Tooth Eruption; Diagnosis; Gingiva; Periodontium.

INTRODUCTION

Eruption is a process of a dental development,beginning from growingin the jawuntil it is inits functional location. The eruption process is a complex phenomenon that is connected to many factors, but genetic, cellular, and molecular factors can lead to differences in the events (1).

Dental anomalies are related to hereditary, local, and systemic factors, or traumatic injuries, and are classified according to number, shape, and size, structure, and color anomalies. Eruption anomalies can be classified into two parts, with respect to time and position. The anomalies associated with time are early and late;the eruption time can vary depending on age, sex, race, and ethnicity. Although the basic biological factor for tooth eruption is root development, chronological age is used as the first diagnosis criterion in premature or delayed eruption (2).

Eruption times have been studied clinically in primary and permanent dentition. Studies have alsoshown that eruption times are gender-specific;girls generally precede boys in tooth eruption (3,4). Tooth eruption physiologically starts when 3/4 of its final root length is formed. The present study shows that root development should be the principal factor to estimatethe time of eruption for different teeth (5). Thus,if an erupted tooth has shorter root length than theexpected 3/4 of root length, its eruption is calledpremature,whereas if the tooth has developed longer than the expected finalroot length for eruption and remains unerupted, it should be defined as delayed eruption (1).

The factors that cause permanent teeth to be delayed are examined as general and local causes. General factors include some systemic diseases and syndromes such as ectodermal dysplasia, cleidocranial dysplasia, Gardner's syndrome, and endocrinopathies. The factors causing at least one delayed tooth eruption are definedbylocal factors such as an odontoma or supernumerary tooth, retention of the primary tooth, ankylosis of the primary and permanent teeth, trauma, ectopic eruption, narrow dental arch, scar tissue and dense bone, mucosal barrier, cyst, tumors, and orofacial cleft (2,6). Delayed tooth eruption has been reported to occur in 28% to 60% of

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white people with supernumerary teeth (7). The mucosal barrier is anetiologic factor for delayed tooth eruption. After hormonal or hereditary causes, vitamin C deficiency, drugs such as phenytoin, or gingival hyperplasia might cause dense connective tissuethat can be an barrier to tooth eruption (8).

Theposition and morphology of anterior teeth have a great importance in facial aesthetics and speaking, especially for physiological eruption. Tooth eruption disturbanceshavebeen seen frequentlyfor the incisor teeth. Delayed tooth eruption in permanent and primary dentitions may be a sign of a systemic disease or a sign of pathologic condition in the craniofacial structure (2). Therefore, detection of delayed eruption is importantin referringthese patients for medical treatment. Additionally, the diagnosis and treatment of the differences are significant in the planning of the orthodontic treatment method selected.

The gingival biotype is a term that determines the soft tissue thickness around the teeth and it wasclassified as thin or thick by Seibert &Lindhe (9). The thick biotype is highly associated with short, wide maxillar central teeth in the male population, while the thin biotype is associated with narrow and extensive maxillary teeth in female population (10,11). Because of the heterogenic populations, no clear assumptions can be made. Thicker biotype (51.9%) is more frequently observed in the population than a thin biotype (42.3%) (12,13).

The hypothesis of the present study is that the thick gingivalbiotypemay lead to delayed eruption. Although there are many studies investigatingthe gingival biotype, there areno studiesthat examine the relationship between delayed eruption and thick gingiva using a probe transparency techniqueindifferent age groups.

The aim of this study is to determine the relationship between biotype and delayed eruptionusingthe probe transparency technique in different age groups.

MATERIAL and METHODS

Patients were admitted tothe Department of Pediatric Dentistry of Kütahya University of Health Sciencesfrom April 2017 to April 2018.In thecross-sectional study, 131 children (mean age,90.21± 27.76 months), including 68 boys and 63 girls aged between 3 and 12 years, were included.

To be eligible, the children were required to be local residents who had no significant medical conditions. All parents were instructed about the benefits and risks of the study and each parents signed a consent form.

Premature loss of primary teeth, syndromes, traumatic injury, and children with local eruption disturbances such as abscess, cyst, and tumors were excluded. Information collected from parents like chronological age, systemic disease, bad oral habits such as finger sucking, nail biting, bruxism, drug use, and Angle classification were recorded. Ethicsapprovalwas obtained from the Ethical Committee of Dumlupınar University, Kütahya(2017, protocol no: 5/9).

Patients were examined in threegroups according to dentition periods: 3–5 years of age in Group 1 (G1), 6–8 years of age in Group 2 (G2), and 9–12 years of age in Group 3 (G3).While the G1 had shown only primary teeth gingival biotype, the G2 and G3 weregrouped according to the time of the anterior and posterior permanent tooth eruption.

Probetransparency technique

The gingival biotype was measuredusing theprobe transparency technique in the maxilla and mandible. A periodontal probe was inserted into the facial aspect of the periodontal sulcus and the gingival biotype wasdefined as thin or thick (Figure 1). In all groups, primary canines were usedas reference teeth (9). All clinical measurements were examined by the same researcher.

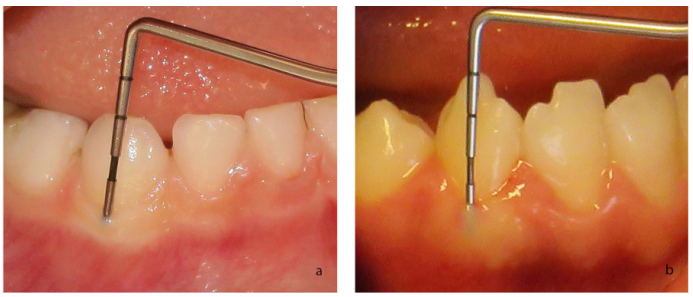

Figure 1. The thick (a) and thin (b) gingival biotype were measured using the probe transparency technique by a periodontal probe

Examination of dental age on digital panoramic radiograph Digital panoramic radiographs were taken from patients. Dental age of the patients wasevaluated based on the Demirjian method usingdigital panoramic radiographs. According tothe Demirjian method, the left mandibular teeth were used from the central incisor to the second molar.Tooth calcification wasestimatedaccording to Demirjian'sindex and each tooth was assigned a letter between "A" and "H". Mineralization stages were given a score, which provides an estimate of the dental maturity on a scale of 0–100 usingpercentile charts. Thedental maturity score was then convertedinto the dental age using the tables providedby Demirjian. Boys and girls had separate tables for all procedures (14).

Determination of eruption times

Karadayı et al. designedthe dental age estimation atlas for Turkish children (15). Thedental age estimation atlas wasdesigned separately for males and females, and also for the maxilla and mandible. Based on this atlas, eruption times were determined as premature, delayed, or on time. Age groups based on the dental age atlas are within the age rangeof 4.5–22.5 years. Eruption times were determined withinthis age range andin accordance with rootdevelopment and mineralization. Thus, in this study,G2 and G3 were compared with the atlas (15).

Statistical analyses

All data management and statistically analyses were performed using IBM SPSS version 24.0 (IBM Corp.

Armonk, NY, USA). Distribution of data was analyzed with Shapiro-Wilk test. The categorical variables between the groups were analyzed using Chi-square testor Fisher's exact test. Descriptive data were shownas a percentage. Thep value<0.05 was considered to be statistically significant to achieve a power of 80%. The minimum required sample size was determined to be 40 in the per study groups.

RESULTS

In the study, 138 children were admitted, but seven children who didnot meet the inclusion criteria of the study were excluded. Finally, 131 children (mean age 90.21 ± 27.76 months), including 68 boys and 63 girls between the ages of 3 and 12 years, were included.Patient demographic information is presented in Table 1. According to chronological age, 95% confidence interval was found as [85.5, 95] months. ??

Table 1. Demographic values

	Oral bad habits		Bruxism	Angle Classification		
	Thumb sucking	Nail- biting		Clas 1	Clas 2	Clas 3
G1	1	6	9	43	0	0
G2	1	10	14	42	4	2
G3	-	1	5	38	2	0

G1: Group 1, G2: Group 2, G3: Group 3

Primary outcomes

For the patients included in this study, according to maxillary biotype 95% confidenceinterval= [0.755, 0.885] and mandibulary biotype 95% confidence interval= [0.568, 0.732] were calculated.

In G1, the thick gingival biotype was observed in 88.4% and 79.1% in the maxilla and mandible, respectively. In G2, thick biotype-related maxillary delayed eruption was observed in 35% of patients. There was no statistically significant difference in the relationship between the maxillary biotype and the maxillary tooth eruption times in all groups (p = 0.361; Table 2).

Table 2. Evaluation of eruption times according to maxillary biotype and maxillary atlas

Group no			Maxillary Atlas			Total	P value
			Premature	On time	Delayed		
G2	Thin	N	2	4	2	8	0.489
		%	25%	50%	25%	100%	
	Thick	N	4	22	14	40	
		%	10%	55%	35%	100%	
	Total	N	6	26	16	48	
		%	12.5%	54.2%	33.3%	100%	
G3	Thin	N	2	8	0	10	0.352
		%	20%	80%	0%	100%	
	Thick	N	10	17	3	30	
		%	33.3%	56.7%	10%	100%	
	Total	N	12	25	3	40	
		%	30%	62.5%	7.5%	100%	

G2: Group 2, G3: Group 3, chi-square test was used for comparison of the thin – thick biotype

In G2, 21.2% ofpatients who had thethick gingival biotype in the mandibular arch showed delayed eruption, but there was no statistically significant difference observed in the relationship (Table 3).

Secondary outcomes

The gingival biotype of boys and girls wasexamined in both jaws. In G1 and G2, the thick gingival biotype was found with ahigh frequency maxillary and mandibulary in boys and girls. The thin gingival biotype was found with a high frequency in mandibular scores for girls in G3. Forthe mandible, the number of patients who had athin gingival biotypeincreased with increasing age. When the maxillary gingival biotype was examined, in all groups, the thick gingival biotype was found at a higher rate in both girls and boyscompared with the thin gingival biotype (Table 4 and Table 5).

Table 3. Evaluation of eruption times according to mandibular biotype and mandibular atlas

Group no			Mandibulary Atlas			Total	P value
			Premature	On time	Delayed		
G2	Thin	N	3	10	2	15	0.677
		%	20%	66.7%	13.3%	100%	
	Thick	N	4	22	7	33	
		%	12.1%	66.7%	21.2%	100%	
	Total	N	7	32	9	48	
		%	7.4%	81.5%	11.1%	100%	
G3	Thin	N	5	13	4	22	0.152
		%	22.7%	59.1%	18.2%	100%	
	Thick	N	6	12	0	18	
		%	33.3%	66.7%	0%	100%	
	Total	N	11	25	4	40	
		%	33.3%	61.9%	4.8%	100%	

G2: Group 2, G3: Group 3 chi-square test was used for comparison of the thin – thick biotype

Table 4. Gender distribution of maxillary gingival biotype

Group No	Gender	Gingival Biotype	Frequency	Percent (%)
G1	Boy	Thin	3	12.5
		Thick	21	87.5
		Total	24	100.0
	Girl	Thin	2	10.5
		Thick	17	89.5
		Total	19	100.0
G2	Boy	Thin	5	17.9
		Thick	23	83.1
		Total	28	100.0
	Girl	Thin	3	15.0
		Thick	17	85.0
		Total	20	100.0
G3	Boy	Thin	3	18.8
		Thick	13	82.2
		Total	16	100.0
	Girl	Thin	7	29.2
		Thick	17	70.8
		Total	24	100.0

Table 5. Gender distribution of mandibular gingival biotype

Group No	Gender	Gingival Biotype	Frequency	Percent (%)
G1	Boy	Thin	3	12.5
		Thick	21	87.5
		Total	24	100.0
	Girl	Thin	6	31,6
		Thick	13	68.4
		Total	19	100.0
G2	Boy	Thin	10	35.7
		Thick	18	64.3
		Total	28	100.0
	Girl	Thin	5	25.0
		Thick	15	75.0
		Total	20	100.0
G3	Boy	Thin	7	43.8
		Thick	9	56.2
		Total	16	100.0
	Girl	Thin	15	62.5
		Thick	9	37.5
		Total	24	100.0

DISCUSSION

Developmental status, tooth eruption, and dental age are particularly significant for pedodontists and orthodontists to make a diagnosis and plan treatment (16,17). The gingival biotype has apositive relationship with the vestibule bone thickness (18). There are no studiesonthe relationship between delayed tooth eruption and gingival biotype. Thus, the present study evaluated the relationship between delayed tooth eruption and gingival biotype.

The hypothesis of the present study is that the thick gingival biotype may lead to delayed eruption. However, our hypothesis was rejected because the results were not statistically significant.

After tooth extraction, bone remodeling isseen duringthe early period of the wound healing (19). Interradicular alveolar bone is resorbed by osteoclasts at 2 to 3 days after extraction and the alveolar socket is filled with newly formed bone tissuewithin 7 days after tooth extraction (20). After the premature loss of primary teeth, the eruption of the permanent teeth is often delayed because of the connective tissue overlying the permanent tooth and the formation of thick, fibrous gingival (1,21).Based on the results of this study, patients who had a tooth extraction in the last 6 months were excluded.

Patients were examined in threegroups based on their dentition periods. Patients in G1had only primary teeth in their mouth. Duringthis period, the gingivaswere examined and comments made about the eruption of permanent teeth. Patients in G2showed eruption of anterior and posterior permanent teeth, upon which comments were made. Eruption of theposterior teeth wasexamined in G3 patients.

Invasive and non-invasive methods were obtained to evaluategingivalbiotype such as direct measurement, probe or probe transparency method, ultrasonic devices, and cone-beam computed tomography (CBCT) scan (22-24). The probe transparency method waschosenwhen determining the gingival biotype because of the fastest, cheapest, most conservative method andit was reproduciblewhen working with children.

Age determination methods in children and adolescents were known astheSchour and Masseler method;Moorees, Fanning and Hunt method; Demirjian, Goldstein and Tanner method;andNolla's method. The method by Demirjian et al. is the most highly recommended technique (14,25). Liversidgesuggests that the Demirjian method is aeffective, beneficial and generally applicable technique to evaluatethe maturity of a child (26). In the present study, the Demirjian method wasused because the atlas also used this method.Additionally, the Demirjian method is preferred because it is highly reproducible (16, 27).

The developmental atlaswasdefined by Karadayı et al., and itprovidesresults for its reference population (15). For this reason, when using a dental age estimation technique, the difference between populations can be seen. Karadayı et al. provided an atlas ofdental development and eruption data for Turkish children and young adults. In the present study, the atlas for Turkish children wasused. The dental age estimation atlas for Turkish childrenshowed tooth development in the maxilla and mandible (15). For the present study, the gingival biotypewasexaminedindividually in both jaws.

During tooth eruption, it is physiological for the marginal gingiva that surrounds erupted teeth to appear prominent. The prominent gingiva is most commonly seen in the maxillary anterior region. Because ofmild inflammation resulting from mastication, the gingiva around the erupting tooth is thicker than the physiological gingiva around the erupted tooth (28).This situation leads to an incorrectmeasurementofgingival thickness. Therefore, in the present study, the gingival biotypewasexamined around the gingiva of the primary canine tooth instead of the gingiva aroundthe incisors in mixed dentition.

Astudy reported that the thick gingival biotype wasseen in 85% of the population (11). Additionally, another studyshowedthat the gingival thickness was associated with age, and also showed thatthe gingiva was thicker in the younger age group (29). Kolte et al. also observed a thicker gingiva in the younger age group but the gingiva was less keratinized and shown to be thinner and with a smallerwidth in females compared to males (30). Similarlyin the present study for all groups, the thick gingival biotype was observed in the maxilla. However,no statistically significant difference was observed in the relationship between the gingival biotype and the eruption time of teeth in all groups. The present study was a preliminary study about this issue and the limitation of the study is thesmall number of patients.

CONCLUSION

In conclusion, our data showed that there was no significant difference between the gingival biotype and the eruption time of teeth in all groups. Eruption time is necessary to determine theappropriate treatment planfor pedodontists and orthodontists. No other study hasexaminedthe relationship between eruption time and thick gingiva using theprobe transparency technique. After this pilot study, further study in all age groupsis required in a larger sample size.

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