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Association between Hypodontia of the Permanent Lateral Incisors and other Dental Anomalies in School Children Aged 12-16 Years in Kosovo

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Abstract

Background: Hypodontia of lateral incisors (LI) is frequently associated with other dental anomalies**.** The objective of this study was to determine the association of LI with other dental anomalies by comparing the two groups: Group 1 with hypodontia of the maxillary LI (MLI1) and Group 2 with hypodontia of the mandibular LI (MLI2), in secondary school education students in Kosovo.

Methods and Results: A total of 3306 secondary school students aged 12-16 years, regardless of gender, were included in this prospective study. The abnormalities investigated were recorded by RTG-panoramic and dental charts. The teeth were recorded as a congenital absence when the mineralization of the crown, identified by panoramic tomography, was absent. In a sample of 3306 subjects, 77(2.3%) subjects were diagnosed with hypodontia. The highest percentage of hypodontia was found in the upper left LI in 20.4% of cases, in the upper right LI in 18.4% of cases, while the percentage of hypodontia of the lower left LI was 0.7% and 2.0% on the right side. A lower percentage of 0.7% or just one missing tooth was found in teeth 13, 32, and 46. The prevalence of LI hypodontia was as follows: MLI1 (Group 1) included 36 cases (92.3%) and MLI2 (Group 2) included only 3 cases (7.6%), which indicates a much higher percentage of cases with hypodontia of MLI1. In Group 1, 21(58.3%) cases of LI hypodontia were bilateral and 15(41.7%) unilateral; in Group 2, 2(66.7%) cases were unilateral and 1(33.3%) case – bilateral.

Among dental anomalies, the occurrence of rotation was found in 19(48.7%) cases with LI hypodontia: 47.2% cases in Group 1 and 66.7% cases in Group 2. The prevalence of dental inclination anomaly was 30.77% of all cases with hypodontia of LI: 27.8% of cases in Group 1 and 66.7% of cases in Group 2. The prevalence of ectopy was in 17.9% of cases of all hypodontia cases of LI: 16.7% of cases in Group 1 and 33.3% of cases in Group 2. Crown anomalies were evident in 7(17.9%) patients of all hypodontia cases of LI, all of which were in Group 1. Other anomalies such as microdontia were evident in two patients in Group 1. Transposition, bodily movement, and superposition were present in one patient in Group 1; in Group 2, one patient had transposition. At the same time, the frequency of dental transposition was significantly higher in Group 2 than in Group 1 (P=0.0209). Other dental anomalies of crown and root and infraposition were not present in both groups. There were no significant differences in the other dental anomalies between the two groups.

Conclusion: The consequences of hypodontia in dental arches are obvious. Knowing the prevalence of hypodontia and its association with other dental anomalies helps classify the need for further treatment for the patients, whether orthodontic, prosthetic, or surgical.(**International Journal of Biomedicine. 2022;12(2):273-278.**)

Key Words: hypodontia • lateral incisors • dental anomalies

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Introduction

Hypodontia is one of the most common developmental anomalies in humans,[1,2] which is characterized by the absence of one or more deciduous or permanent teeth, as well as on both upper and lower dentitions.[3] Hypodontia can cause masticatory dysfunction, impact speech, create aesthetic problems with psychological implications affecting self-esteem,[4] and cause the need for orthodontic treatment and prosthetic compensation in some cases. Hypodontia of lateral incisors (LI) is frequently associated with other dental anomalies**.**

A variety of terminology describes this anomaly in the literature, such as tooth aplasia, congenitally missing teeth, missing teeth, dental agenesis, oligodontia, or anodontia.

The appearance of dental agenesis in permanent dentition varies. Polder et al., using meta-analysis, found that the prevalence of missing permanent teeth varies from 2.2% to 10.1%, excluding third molars, which are missing in about 20% of the general population.[5] This anomaly has multifactorial etiology, including genetic factors, phylogenetic and environmental factors,[6,7] and has variability in the size of the teeth, most often characterized by microdontia.[8]

The absence of anterior teeth and disorders regarding the position of the other teeth cause malocclusions that directly affect both function and aesthetics.[9-11]

The appearance of unilateral hypodontia in LI is, in most cases, accompanied by changes in the shape and size (peg-shaped) of the same tooth on the opposite side of the jaw. This means that both abnormalities deviate from the same genes, but the difference lies in changes in gene expressiveness. In people with permanent dental hypodontia, the persistence of a deciduous tooth is often seen as a result of the absence of a permanent tooth. This includes the second deciduous mandibular molars and deciduous maxillary canines. In the absence of a permanent upper lateral incisor, the canine migrates forward and emerges between the central incisor and the deciduous canine.[12]

Hypodontia in deciduous teeth is a relatively rare phenomenon. The prevalence is from 0.1% to 0.9%.[13] This anomaly is more often localized in the maxilla than in the mandible, while the missing teeth are usually the upper LI. Hypodontia of a deciduous tooth in primary dentition can also be associated with hypodontia of the same tooth in permanent dentition.[14]

The persistence of deciduous teeth often occurs in association with hypodontia. As a result, when a tooth is missing, it is thought that there is a lack of impulse for resorption of the root of the deciduous tooth, which results in the tooth remaining in the jaw for a long time. We often notice the persistence of deciduous canines in cases with hypodontia. As a result of hypodontia, deciduous teeth are prevalent because their root resorption is not helped due to the missing permanent teeth. According to some authors, the retention of primary teeth prevents the vertical development of the alveolar process.[15,16]

The prevalence of hypodontia of permanent maxillary LI ranges from 6% to 8% in different ethnic groups, and molecular genetics has identified shared genetic mutations in families with tooth agenesis.[17] Hypodontia of permanent maxillary LI is also associated with other dental anomalies, while the same genetic mutation may have a variable phenotypical expression.[18]

There have also been suggestions of various inheritance models related to this anomaly, including dominant autosomal incomplete penetration, recessive autosomal, gender-linked inheritance, and polygenic inheritance model. These genes are associated with about 120 syndromes, such as cleft lip, cleft palate, and ectodermal dysplasia, as well as Down, Rieger, and Book Syndromes.[19]

Hypodontia of LI is not an isolated phenomenon because they are often reported associated with other dental anomalies, such as LI in the form of a peg, transposition, delayed tooth development, ectopic eruption, stagnant deciduous teeth, inclination, infraposition, and other anomalies in the size and shape of the teeth.[12] A study of orthodontic patients with at least one canine in the palatal ectopic position showed that LI near these canines were missing in a high percentage of cases.[20]

Peg-shaped maxillary LI were found in 5.5% of family members (probands) with hypodontia, compared with a frequency of 1.7% of the general population.[21] In a study by Alvesalo and Portin, the frequency and inheritance models were researched, and it was observed that the peg-shaped upper LI and the mesiodistal reduction of the upper LI are strongly different expressions of the autosomal dominant gene with reduced penetration.[22]

Hypodontia has a strong connection with microdontia. Congenital absence of LI is often associated with a reduced tooth on the contralateral side with genetic etiology that, combined with hypodontia, can result in multiple diastemas and rotations of adjacent teeth.[23] Previous studies have reported an association between hypodontia of maxillary incisors and other dental anomalies such as transposition,[24] displacement of palatal canines,[25] and premolar rotation.[26]

The studies about the differences between hypodontia of maxillary and mandibular LI regarding their association with other dental anomalies are scarce. In this study, we aimed to investigate whether hypodontia of the maxillary LI has a higher prevalence in the presence of other dental abnormalities compared to the hypodontia group of mandibular LI. This research may provide further evidence on the field-specific genetic control of tooth development.

The objective of this study was to determine the association of LI with other dental anomalies by comparing the two groups: Group 1 with hypodontia of the maxillary LI (MLI1) and Group 2 with hypodontia of the mandibular LI (MLI2), in secondary school education students in Kosovo.

Materials and Methods

A total of 3306 secondary school students aged 12-16 years, regardless of gender, were included in this prospective study. All students attended their respective secondary schools throughout Kosovo. The selection of schools and participants was random, involving all regions of the country, both rural and urban. Examinations were performed by orthodontics and dentistry specialists. The abnormalities investigated were recorded by RTG-panoramic and dental charts. The teeth were recorded as a congenital absence when the mineralization of the crown, identified by panoramic tomography, was absent. The excluding criteria were a history of tooth loss from trauma, caries, periodontal disease, or orthodontic extractions.

The order of patients, based on age, was therefore selected by taking into account the delayed development of second mandibular premolars in boys[24] and according to the dental stage classification developed by Björk.[25]

Inclusion criteria were children of both genders from all regions and secondary schools throughout the country, subjects with all teeth present, students who have no previous history of trauma according to the anamnesis.

Exclusion criteria were students who provided data showing a previous history of tooth loss due to trauma, caries, periodontal disease, or orthodontic extractions; subjects with hypodontia associated with congenital syndromes or systemic diseases; all suspected cases in medical history and clinical examination.

The sample selection was made through the "cluster sampling" technique. This was based on the radiography verification of hypodontia, which was completed for all teeth, excluding the third molars from the study. The file for each subject was reviewed for medical histories, dental and family histories, and study models of maxillary and mandibular dental arches.

Statistical analysis was performed using statistical software package SPSS version 20.0 (Armonk, NY: IBM Corp.). Baseline characteristics were summarized as frequencies and percentages for categorical variables. The frequencies of categorical variables were compared using Pearson's chi-squared test or Fisher's exact test (2-tail), when appropriate. A two-proportion z-test was used to determine whether the two proportions were different from each other. A value of $P<0.05$ was considered significant.

This study was approved by the Ethics Committee of the Faculty of Medicine, the University of Prishtina, supported by the Ministry of Science and Education and the University Dental Clinical Center of Kosovo. Written informed consent was obtained from the parent/guardian/relative of each patient.

Results

In a sample of 3306 subjects aged 12-16 years, 77(2.3%) subjects were diagnosed with hypodontia (Table 1).

Table 1.

Presentation of cases frequency by gender, hypodontia and hypodontia in jaw, including LI hypodontia

Gender	Number of cases, n (%)	Hypodontia frequency	Hypodontia in jaw			Hypodontia of LI	
			Maxillary	Mandibular	Both	Yes	No
Female	1566 (47.4%)	46 (2.9%)	26 (56.5%)	13 (28.3%)	7 (15.2%)	23 (1.47%)	23 (1.47%)
Male	1740 (52.6%)	31 (1.8%)	20 (64.5%)	8 (25.8%)	3 (9.7%)	16 (0.92%)	15 (0.86%)
Total	3306	77 (2.3%)	46 (59.7%)	21 (27.3%)	10 (13.0%)	39 (1.18%)	38 (1.15%)

Regarding the gender groups, 46(2.9%) were female and 31(1.80%) male. There were significant differences between the gender groups (z=2.2, P=0.0278). Among all 77 hypodontia cases, the presence of jaw-based hypodontia was 46(59.7%) cases in the maxillary jaw and 21(27.3%) cases in the mandibular jaw. Hypodontia of both jaws was present in 10(13.0%) cases. There were no significant differences between groups based on gender and jaw hypodontia. The prevalence of LI hypodontia was 1.18% or 39 cases in the total sample. The presence of LI hypodontia was 39(50.6%) of overall hypodontia cases, of which 23(58.9%) were female and 16(41.3%) male.

The highest percentage of hypodontia was found in the upper left LI in 20.4% of cases, in the upper right LI in 18.4% of cases, while the percentage of hypodontia of the lower left LI was 0.7% and 2.0% on the right side (Table 2). A lower percentage of 0.7% or just one missing tooth was found in teeth 13, 32, and 46.

Table 2.

Frequency of affected teeth (FDI notation) in hypodontia subjects

Affected teeth	Number of cases	Percentage
12	27	18.4
13	1	0.7
14	10	6.8
15	6	4.1
22	30	20.4
23	4	2.7
24	11	7.5
25	5	3.4
31	3	2.0
32	1	0.7
34	7	4.8
35	12	8.2
41	4	2.7
42	3	2.0
44	10	6.8
45	12	8.2
46	1	0.7
Total	147	100

The prevalence of LI hypodontia was as follows: MLI1 (Group 1) included 36 cases (92.3%) and MLI2 (Group 2) included only 3 cases (7.6%), which indicates a much higher percentage of cases with hypodontia of MLI1 (Table 3). In Group 1, 21(58.3%) cases of hypodontia were bilateral and 15(41.7%) unilateral; in Group 2, 2(66.7%) cases were unilateral and 1(33.3%) case – bilateral.

Among dental anomalies, the occurrence of rotation was found in 19(48.7%) cases with LI hypodontia: 47.2% cases in Group 1 and 66.7% cases in Group 2. The prevalence of dental inclination anomaly was 30.77% of all cases with hypodontia of LI: 27.8% of cases in Group 1 and 66.7% of cases in Group 2. The prevalence of ectopy was in 17.9% of cases of all hypodontia cases of LI: 16.7% in Group 1 and 33.3% of cases in Group 2. Crown anomalies were evident in 7(17.9%) patients of all hypodontia cases of LI, all of which were in Group 1. Other anomalies such as microdontia were evident in two patients in Group 1. Transposition, bodily movement, and superposition were present in one patient in Group 1; in Group 2, one patient had transposition. Other dental anomalies of crown and root and infraposition were not present in both groups. At the same time, the frequency of dental transposition was significantly higher in Group 2 than in Group 1 (P=0.02088). There were no significant differences in the other dental anomalies between the two groups.

Table 3.
The presentation of the frequency and distribution of dental anomalies in the group with hypodontia of MLI1 and MLI2

Dental anomaly	Group 1 (Hypodontia of the MLI1)								Group 2 (Hypodontia of the MLI2)					
	Uni-lateral		Uni-lateral		Bila-teral		Total		Uni-lateral		Bila-teral		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
	6	16.7	9	25.0	21	58.3	36	100	2	66.7	1	33.3	3	100
	12		22		12-22				42		32-42			
Rotation	4		6		7		17		2		0		2	
Inclination	3		3		4		10		2		0		2	
Bodily	0		0		1		1		0		0		0	
Superposition	0		1		0		1		0		0		0	
Infraposition	0		0		0		0		0		0		0	
Ectopia	2		4		0		6		1		0		1	
Transposition	0		1		0		1		1		0		1	
Crown anomaly	3		3		1		7		0		0		0	
Root anomaly	0		0		0		0		0		0		0	
Microdontia	1		0		1		2		0		0		0	

Table 4.
Distribution and prevalence of dental anomalies in groups MLI1 and MLI2

Dental anomaly	Group 1 (MLI1) (n=36)	Group 2 (MLI2) (n=3)	Statistics	
	n (%)	n (%)	z-score	*P*-value
Rotation	17 (47.2)	2 (66.7)	-0.6474	0.5157
Inclination	10 (27.8)	2 (66.7)	-1.4022	0.16152
Bodily	1 (2.8)	0	0.2924	0.77182
Superposition	1 (2.8)	0	0.2924	0.77182
Infraposition	0	0	-	-
Ectopia	6 (16.7)	1 (33.3)	-0.7227	0.47152
Transposition	1 (2.8)	1 (33.3)	-2.3053	0.02088
Crown anomaly	7 (19.4)	0	0.8432	0.4009
Root anomaly	0	0	-	-
Microdontion	2 (5.6)	0	0.4191	0.67448

Discussion

The data of our study, with a higher prevalence among females than males, follows the studies of Gokkaya & Kargul[27] and Badrov et al.[28] Also, the findings of the ratio of male to female, which was 1:1.4 in our study, is similar to the studies done by Baceti [26] and Muller et al.[29] but differ from the findings of Albashaireh & Khader,[30] Maklin et al.,[31] Rölling,[32] and Aasheim & Ogaard.[33]

The most common missing teeth are the LI of the upper jaw on the left side in 20.5% of cases and the right side in 17.8% of cases, followed by the second premolars of the lower and upper jaw (10%), which is consistent with some studies.[11,34] The frequency of LI hypodontia in our study was higher in 50.6% of all cases with hypodontia, and similar results were found in the studies by Pinho et al.,[35] Celikoglu et al.,[36] and Silve Meza R.[37] The prevalence of hypodontia of maxillary LI was 46.7% of the total sample with hypodontia and is similar to the findings of a study by Al-Abdallah et al.[38]

In our study, the prevalence of uni- and bilateral maxillary LI hypodontia was 1.09% of the total sample and is consistent with other reported studies ranging from 0.3% to 11.3%.[3,37,39] According to a meta-analysis, the prevalence of agenesis of permanent teeth in the general population, excluding third molars, ranges from 3.2% to 7.6%.[34] This prevalence varies according to the tooth type. For example, hypodontia of maxillary LI was 1.7% of all samples, which is similar to our findings.

Bilateral agenesis of the maxillary LI occurs more frequently than unilateral agenesis.[40-43] Our study also shows a higher frequency of agenesis of bilateral maxillary LI in 56.4% of cases, but other studies by Pinho et al.[35] and Delli K et al.[44] showed less frequency of bilateral than unilateral agenesis.

A study by Celikoglu et al.[36] found significantly increased prevalence rates for ectopic eruption, transposition, and transmigration of the maxillary canines and reduced or peg-shaped maxillary LIs in their study sample. This is similar to the findings in our study, where the results indicate a high prevalence of dental anomalies, such as rotation, inclination, ectopic, and corona anomalies, in the group of patients with hypodontia of LI. Rotation of premolars was significantly associated with congenitally missing maxillary LI in the study by Baccetti.[26] This result was similar to the findings in our study, where we found a high prevalence of the dental rotation anomaly [19(48.7%) cases with LI hypodontia].

The lateral incisor of the maxilla was the tooth most often missing congenitally, as in the study of Augard & Gayard.[45] However, this is not consistent with the study of Al-Mulla et al.[46] who found that the second premolar of the mandibula is the most frequently missing tooth.

In a study about hypodontia, a critical issue is the patient's age at the time of the diagnosis, which tells us that the visibility of the dental germ on radiography depends on the stage of tooth mineralization.[43] The stages of tooth development are more closely related to tooth mineralization than the chronological age of tooth eruption.[47] Unilateral hypodontia is often associated with dysmorphia or microdontia corresponding to the contralateral tooth.[48] In another study by Pinho et al.,[49] the findings indicate that microdontia of the maxillary LI may represent a presentation of the molecular changes that lead to a developing defect of the maxillary lateral incisors. Therefore, considerable emphasis should be placed on the clinical diagnosis or family history where we may suspect missing teeth, and the treatment option for closing the spaces becomes unreal from the orthodontic aspect.[50]

Considering that the possibilities of treating patients with hypodontia are wide during treatment planning,[51] it is necessary to know the number of missing teeth, especially in the intercanine sector, the size of the teeth, the condition

of the teeth present, the condition of the periodontium, the position of the teeth, alveolar bone mass, general and local health status (soft tissue, lip line, gingival aesthetic condition, malocclusions, patient's age, the attitude of the child and parents towards the anomaly, occlusion, etiological factors, technical and financial possibilities of solving the problem).

Recognizing the prevalence and different models of hypodontia, strategies are created to treat this anomaly, which is not only statistically important but also important for the formation of an interdisciplinary professional team to cooperate in planning successful treatment.

The consequences of hypodontia in dental arches are obvious. Depending on the models of hypodontia, the need for the treatment ranges from simple to intensive. The problems that can occur in these patients are extensive, such that each case needs to be considered uniquely, in terms of approach and treatment. Knowing the prevalence of hypodontia and its association with other dental anomalies helps classify the need for further treatment for the patients, whether orthodontic, prosthetic, or surgical.

In our study, there were dental abnormalities associated with dental agenesis, which should be sought and investigated in patients with agenesis. It is particularly necessary, for those with agenesis of upper lateral incisors, and especially in young children for whom it is crucial that the orthodontist intercept these anomalies as early as possible, in order to establish proper treatment. The time-consuming and financial cost of extensive treatments of this anomaly is of interest to numerous clinical, basic science, and public health fields, such as orthodontics, pediatric dentistry, prosthodontics, periodontics, maxillofacial surgery, anatomy, anthropology, and even to the insurance companies.

Competing Interests

The authors declare that they have no competing interests.

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