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Стаття надійшла 17.05.2023 р.

DOI 10.26724/2079-8334-2024-2-88-40-44

UDC [612.311.1+616.314-007.1]:616-053.5

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## MODERN TRENDS IN THE ERUPTION OF PERMANENT TEETH DURING THE LATE MIXED DENTITION PERIOD

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The study was devoted to establishing the regional terms of permanent teeth eruption in 9–12-year-old children of the city of Odessa. Dental examination was performed according to the generally accepted methodology using standard dental instruments included in the examination kit. Children were divided into groups according to their age and sex. Patients were examined on the basis of the values of age and period of teeth eruption. The results of the study indicate an earlier formation of a permanent bite in the majority of the examined children. In the examined girls, the formation of a permanent bite was completed earlier than in boys. The obtained research data should be taken into account when planning and developing a program for the prevention of major dental diseases, as well as used to establish biological maturity and determine the overall development of the child.

**Key words:** eruption of teeth, jaws, permanent teeth, children, oral health.

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## СУЧАСНІ ТЕНДЕНЦІЇ ПРОРІЗУВАННЯ ПОСТІЙНИХ ЗУБІВ У ПЕРІОД ПІЗЬНОГО ЗМІННОГО ПРИКУСУ

Дослідження присвячене встановленню регіональних термінів прорізування постійних зубів у дітей 9–12 років міста Одеси. Стоматологічне обстеження проводили за загальноприйнятою методикою з використанням стандартного стоматологічного інструментарію, що входить до набору для обстеження. Діти були розподілені на групи відповідно до віку та статі. Пацієнтів обстежували на основі значень віку та періоду прорізування зубів. проведені досліджень свідчать про більш раннє формуванні постійного прикусу у більшості обстежених дітей. У обстежених дівчат формування постійного прикусу завершувалось раніше, ніж у хлопчиків. Отримані дані дослідження необхідно враховувати під час планування та розробки програми профілактики основних стоматологічних захворювань, а також використовувати при встановленні біологічної зрілості та визначенні загального розвитку дитини.

**Ключові слова:** прорізування зубів, щелепи, постійні зуби, діти, здоров'я порожнини рота.

*The work is a fragment of the research project "Improvement of diagnostics, prevention and treatment of teeth hard tissues mineralization processes violations in children", state registration No. 0121U114421.*

Tooth eruption is a complex physiological process, which is the movement of a tooth from the place of its insertion in the alveolar bone to the occlusal surface in the oral cavity [8]. The analysis of modern literature data indicates the absence of a single universal theory of tooth eruption that can provide comprehensive explanations for numerous factors obtained in the study of the stages of tooth development and its possible disorders. However, the described mechanisms often complement each other, which makes teething a complex multifactorial process that combines the action of several mechanisms [1].

The eruption process is strictly regulated, so deviations from the established norms must be detected in time and the causes of such deviations diagnosed, as tooth eruption is an important marker of the patient's health and development. During the physiological development of a child, the eruption of permanent teeth coincides with the complete resorption of the roots of temporary teeth. These processes are closely related to the growth and development of the child's dentition. Studying the process of eruption of permanent teeth in children is important for practical medicine. Disorders of the terms and sequence of tooth eruption can be a manifestation of diseases manifested in the form of impaired physiological craniofacial development [5, 8].

Tooth eruption may also depend on local factors of the oral cavity: the depth of the tooth rudiments, the structure of the alveolar bone tissue. Injuries to primary teeth and untreated complications of primary teeth caries, in addition to disrupting the mineralization of the hard tissues of permanent teeth, can also lead to changes in the timing of their eruption. There is a direct correlation between the development of various types of dentoalveolar anomalies and the terms of tooth eruption [13].

The scientific literature describes a number of genetic disorders that affect teething. Most of them delay the eruption of permanent teeth, while others are associated with early eruption and can lead to a complete absence of eruption [9, 10].

The physiological timing of eruption may depend on the climatic conditions of residence, the child's racial origin, and heredity. It has also been established that the eruption of permanent teeth is influenced by many physiological parameters: heredity, gender, time of puberty, nutrition, genetic, socioeconomic and environmental factors [6, 11, 12].

It is known that control over the timing of eruption is a non-invasive and cost-effective research method that allows to identify disorders of the child's overall development.

The modern terms of tooth eruption are necessary indicators for pediatricians, pediatric dentists and orthodontists, as they provide important information about the processes of growth and development of the body, and make it possible to determine the biological age of the child. There is a direct relationship between osteogenesis and tooth eruption. For this reason, tooth eruption, along with the state of the skeletal system, is used to judge the physiological maturity of the body [10].

In addition, age estimation by the number of erupted teeth is of paramount importance in demographic studies, forensics, and anthropology [7]. Without the availability of up-to-date eruption terms, rational planning of municipal programs for the prevention of major dental diseases is impossible.

Based on the above, there is a necessity to find out the actual terms of appearance and establish a scheme of the sequence of tooth eruption in children.

**The purpose** of the study was to establish the regional terms of permanent teeth eruption in 9–12-year-old children of the city of Odesa.

**Materials and methods.** We conducted a dental examination of children aged 9 to 12 years of both sexes. Dental examinations of children were carried out by random sampling in the dental office at the clinical base of the department of pediatric dentistry of Odesa national medical university (Department of pediatric dental health of the multidisciplinary medical center of ONMedU) and the Department of Epidemiology and Prevention of Major Dental Diseases, Pediatric Dentistry and Orthodontics of the SE “The Institute of stomatology and maxilla-facial surgery National academy of medical sciences of Ukraine” (SE “ISMFS NAMS”). The examination data were recorded in charts of dental examination of the child's oral cavity developed in the Pediatric Dentistry Department of SE “ISMFS NAMS”. The examination was performed according to the generally accepted methodology using standard dental instruments included in the examination kit. Children were divided into groups according to their age and sex. Patients were examined according to the scheme: the full daily age of the child, dental formula, and the degree of eruption of permanent teeth were recorded. The age at which a tooth erupted in 5 % of the patients was considered to be the beginning of eruption; the age at which a tooth erupted in 50 % of the patients was considered to be the average age of eruption; the age at which a tooth erupted in 95 % or more of the patients was considered to be the end of eruption [3].

The results were processed by variational statistical methods of analysis using the Microsoft Office Excel 2016 software [4].

**Results of the study and their discussion.** As a result of the study, it was found that the majority of the examined children in the city of Odesa began the late mixed dentition period with the eruption of the first premolars (Table 1, Table 2). Exceptions were children who had second molars of temporary teeth extracted due to caries complications, which resulted in early eruption of the second premolar. Such cases were most often observed in children in the upper jaw. It should be emphasized that the period of late mixed dentition in children began at an earlier age than generally expected. This trend can be explained by the

urbanization of the population and the global acceleration of human development. At the same time, this trend was more pronounced in girls.

Table 1

**Permanent teeth eruption in children on the upper jaw (%)**

Age	Sex	Tooth							
		1.7	1.5	1.4	1.3	2.3	2.4	2.5	2.7
9	Boys	0	26	36	8	8	40	26	0
	Girls	0	30	44	12	12	40	30	0
9.5	Boys	0	64	76	26	26	70	64	0
	Girls	4	66	82	32	32	82	66	2
10	Boys	8	86	98	76	76	98	86	6
	Girls	14	96	100	80	80	100	96	14
10.5	Boys	30	98	100	84	84	100	98	30
	Girls	40	98	100	96	96	100	98	40
11	Boys	58	100	100	96	96	100	100	58
	Girls	70	100	100	98	98	100	98	72
11.5	Boys	82	98	100	98	100	100	98	82
	Girls	96	98	100	100	98	100	100	96
12	Boys	96	98	100	100	100	100	98	96
	Girls	98	100	100	100	100	100	100	98

According to the regulation on the symmetry of eruption, the teeth should erupt simultaneously or with a slight time difference on one jaw. However, strict symmetry was not always observed. The difference was often observed in the eruption of the first and second premolars. Thus, in 44 % of girls aged 9 years, the right first premolar erupted in the upper jaw, and the left in 40 %. In 76 % of boys aged 9.5 years, the right first premolar erupted in the upper jaw, and the left in 70 %. In addition, asymmetrical eruption was caused by premature loss of temporary teeth due to their extraction as a result of caries complications or lack of treatment of its complications, and less often by loss caused by trauma.

Table 2

**Permanent teeth eruption in children on the lower jaw (%)**

Age	Sex	Tooth							
		4.7	4.5	4.4	4.3	3.3	3.4	3.5	3.7
9	Boys	0	30	38	16	16	38	30	0
	Girls	0	28	38	18	18	38	28	0
9.5	Boys	0	62	76	26	26	76	62	2
	Girls	2	64	82	32	32	82	64	2
10	Boys	10	84	98	76	76	98	84	10
	Girls	14	96	100	80	80	100	98	12
10.5	Boys	46	96	100	84	84	100	96	46
	Girls	54	96	100	96	96	100	96	56
11	Boys	70	100	100	96	96	100	100	70
	Girls	74	100	100	98	98	100	100	74
11.5	Boys	96	100	100	98	100	100	100	96
	Girls	96	100	100	100	98	100	100	96
12	Boys	98	98	100	100	100	100	100	96
	Girls	98	100	100	100	100	100	100	98

Figures 1 and 2 elucidate the chronological emergence patterns of permanent teeth within a demographic subset of Odesan children, delineating the specific age brackets indicative of the onset, median eruption age, and culminating phase of tooth eruption for pivotal dental markers. These graphical representations are bifurcated into two distinct panels for each figure: Panel A illustrates the sequential emergence of teeth within the maxillary arch, whereas Panel B correlates these events with those transpiring in the mandibular arch.

Figure 1 encapsulates the eruption chronology for the male subset, with bar graphs demarcating the threshold age (commencement at 5th percentile), mean eruption age (50th percentile median), and the closure of eruption phase (completion at 95th percentile). In parallel, Figure 2 delineates these developmental landmarks for the female cohort, fostering an analytical juxtaposition across the sexes.

A thorough examination of the data reveals an inclination towards earlier-than-anticipated tooth eruption within this population, particularly pronounced in the female subjects. This gender-specific deviation is evidenced by the advanced eruption of the second molars in girls, which finalize roughly six

months prior to their male counterparts, at the ages of 11.5 and 12 years, respectively. Similarly, the completion of canine tooth eruption also adheres to this expedited pattern, concluding at 10.5 years for females as opposed to 11 years for males.

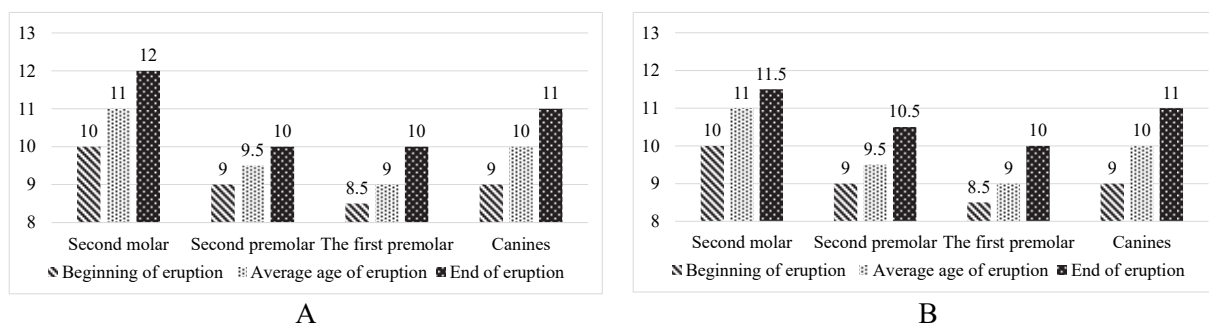


Fig. 1. Terms of tooth eruption in boys. A – on the upper jaw. B – on the lower jaw.

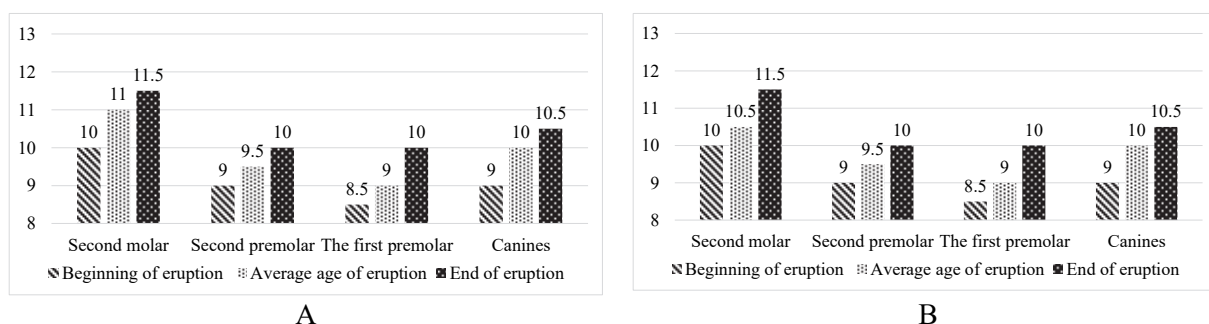


Fig. 2. Terms of tooth eruption in girls. A – on the upper jaw. B – on the lower jaw.

These variations have substantive implications that transcend mere clinical observations, touching upon broader developmental processes. The incidence of advanced dental eruption could potentially act as a prognostic indicator for individual growth patterns, with early eruption signaling accelerated biological development. Conversely, disruption of eruption terms not only may reflect developmental delays but also predispose pediatric patients to heightened risks of dental caries. This predisposition could stem from a delay in the mineralization process of the tooth's hard structure, leading to a compromised enamel integrity that is less resilient to carious attacks.

These findings urge a reassessment of pediatric dental milestones and potentially call for tailored interventions in both preventive and diagnostic dentistry. Such data-driven insights could refine the predictive models for dental development, enabling clinicians to better anticipate and manage potential complications arising from anomalous eruption patterns. Furthermore, these observations warrant additional research to ascertain the underlying biological, environmental, and perhaps socio-economic determinants that might contribute to these regional variances in tooth eruption chronology.

The results of the current study underscore the variances in the eruption timing of permanent teeth among children aged 9–12 years in Odesa. These findings are instrumental in augmenting the existing literature, providing a localized perspective that complements broader epidemiological data. Significantly, our study corroborates earlier research indicating that permanent teeth eruption can occur earlier than traditionally expected [5–7]. This pattern is particularly pronounced among female participants, suggesting potential influences of biological and hormonal factors that may accelerate dental maturation in girls compared to boys [13]. Such gender-specific differences are supported by other studies, which have demonstrated similar trends in dental development [8, 9]. The discrepancies in eruption times between sexes and between upper and lower jaws observed in our cohort also reflect the complex interplay of genetic, nutritional, and environmental factors [6, 11, 12]. These factors are essential in understanding the biological and physiological underpinnings of dental development. The data align with the findings from other regions, suggesting that such variations are not unique to the population of Odesa but may instead represent a broader, possibly global trend [10]. Furthermore, our data are in agreement with the eruption norms presented in contemporary Ukrainian dental textbooks and align closely with the reported norms [1, 2]. The comparison of these normative data with our findings suggests that while the general patterns of eruption are consistent, regional variations do exist. This highlights the necessity for localized studies to accurately define dental eruption timelines, which are crucial for pediatric and orthodontic treatment planning [1, 2]. The advanced eruption terms observed could also have clinical implications. For instance, earlier eruption may predispose to certain dental anomalies or could be indicative of other systemic

conditions, thus requiring careful monitoring [5, 7]. Additionally, the variation in eruption terms could affect the scheduling of preventive and therapeutic interventions, which are pivotal in managing the overall oral health of children [4]. The role of local factors, such as urbanization and associated lifestyle changes, in influencing eruption patterns cannot be overlooked. Our findings suggest that these factors may be contributing to the acceleration of physiological development, as has been observed in other urban settings [3, 6]. This urbanization effect might be linked to changes in nutrition, healthcare access, and overall socio-economic conditions, which merit further investigation. In conclusion, the earlier formation of a permanent dentition observed in the majority of children studied underscores the importance of regular monitoring from an early age. This is crucial not only for detecting possible anomalies but also for ensuring timely orthodontic intervention. Our study adds valuable regional data to the global understanding of tooth eruption, highlighting the need for continuous updating of dental health guidelines and intervention programs based on current and localized data [2, 9]. These findings should be taken into consideration by pediatricians and orthodontists in planning and optimizing the timing of interventions to manage and prevent dental and orthodontic issues effectively.

### Conclusions

1. The results of these studies indicate an earlier formation of permanent dentition in most of the children studied. This indicates the importance of regular monitoring of the development of the dento-mandibular system from the earliest age and emphasizes the need for timely detection of possible anomalies and deviations from the norm.

2. The completion of permanent bite formation in girls compared to boys may be due to differences in the hormonal background and biological features of the organism. This fact emphasizes the importance of taking into account the individual characteristics of each child when planning orthodontic treatment and determining the optimal time for its start.

3. The obtained research data should be taken into account when planning and developing a program for the prevention of major dental diseases, as well as used to establish biological maturity and determine the overall development of the child.

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Стаття надійшла 7.04.2023 р.