



## COMPLEX VIEW OF THE ERUPTION OF THE PERMANENT TEETH

Boyan Kirilov

*Department of Anthropology and Anatomy, Institute of Experimental Morphology, Pathology and Anthropology with Museum, Bulgarian Academy of Sciences, Sofia, Bulgaria.*

### ABSTRACT:

The eruption of the permanent teeth is one of the main features used to determine the biological maturity of an individual. The present literature review shows a correlation between studies carried out in different years and countries for the factors influencing the erupting of teeth. Data regarding the role of social factors, sex, diet, height, weight, Body Mass Index (BMI), factors in pregnancy, diseases at a young age, hereditary elements and genetics is analyzed. Tooth eruption in the context of secular trends is observed and attention is paid to the Bulgarian contribution to the study of this topic. The conclusion presents the importance of collaboration between different specialists in the preparation and execution of complex treatment plans.

**Keywords:** tooth eruption, factors, BMI, children,

### BACKGROUND

The eruption of teeth is one of the most important indicators for the normal development of the facial complex, teeth, jaws and the biological age of an individual.

Tooth eruption is a prolonged biological process during which teeth penetrate through the bones and mucosal layer covering them and appear in the oral cavity. It is the first clinically established stage of tooth formation, which follows a specific sequence and it is connected with the age of the individual.

The initiation of development of the permanent teeth begins during pregnancy and the formation of their structures continues after their eruption between 5 and 14 years of age [1]. Eruption starts at 6-7 years of age with the first permanent molar or central incisor of the mandible and continues with the lateral incisors, first premolars, canines, second premolars and second molars. Last to erupt are the third molars – between the ages of 17 and 21 years.

Knowledge regarding the development and eruption of teeth has been successfully used in clinical practice - particularly in pediatrics - for the evaluation of biological maturity and the morpho-functional condition of the child throughout their growth. It is also used in anthropology and forensic medicine to identify bone material and determine age. According to some authors, the most informative indicator of biological maturity in pre-school and school age children are the dynamics with which the length

of the clinical crown of the permanent teeth is increasing [2] and the times of eruption of the first molars and central incisors [3]. In dentistry, the timing of the eruption of the permanent teeth is used to evaluate the disturbances of the process of eruption and in the making of treatment plans, used mostly in orthodontics. Evaluation of time, sequence and features of the eruption of the particular groups of teeth makes it possible to establish if the process of tooth eruption is normal, retained, retarded or complicated and, respectively, to take timely measures to optimise children's oral health [4]. It is noted that the process of tooth development in children of the same age group from different ethnic groups and specific geographical regions differs, which reflects on the accuracy in determining tooth age. These differences could be due to genetic factors, differences in lifestyle and living conditions, climate, socio-economic status, nutrition and diseases. The methodology of conducting the research can lead to difference in the evaluation of the process of eruption [5].

The **aim** of the current review is to summarize the available literature regarding the factors influencing the process of tooth eruption.

### REVIEW RESULTS

A variety of research is dedicated to study the factors that affect the process of eruption of the teeth in children. As a part of their physical development, tooth eruption is affected from a number of endogenic (genetic, hormonal) and exogenic (socio-economic, geographical, etc.) factors. Heredity, the specifics of an individual's development, sex, somatic pathology, nutrition, socio-economic factors, and also factors which were present during pregnancy have a significant impact on tooth eruption [6].

The role of **heredity** and **genetic factors** has been examined in a number of studies. More than 300 genes are responsible for the formation and eruption of teeth. Some of them, through the endocrine system, affect the growth rate of the organism, other factors determine the gradient of enlargement and sequence of eruption of the teeth. Some genetic diseases also affect the eruption of teeth [7]. Most genetic and hereditary diseases result in retardation of tooth eruption (Tabl. 1) and in some even a complete absence of eruption (Tabl. 2).

**Table 1.** Genetic diseases associated with retardation in tooth eruption.

Gorlin's syndrome	Chondroectodermal dysplasia
Ectodermal dysplasia	Cleidocranial dysplasia
Osteogenesis Imperfecta	Osteopetrosis
Gardner's syndrome	Neurofibromatosis
Albright's syndrome	Parry-Romberg's syndrome
Cherubism	Gaucher's syndrome

**Table 2.** Genetic diseases associated with absence of tooth eruption.

Down's syndrome	Apert's syndrome
Progeria (Hutchinson-Gilford's syndrome)	Carpenter's syndrome

Other accompanying diseases which affect the initiation of the formation of the dental germs, mineralization and the process of eruption also play a major role in the function of the maxillofacial complex. According to the already cited work of M. Kotchetova, the main diseases that play a role in tooth formation and eruption are hormonal, especially those affecting the thyroid gland. In hypothyroidism, hypopituitarism, hypoparathyroidism and pseudohypoparathyroidism are found to delay tooth eruption. Earlier tooth eruption is found in hyperthyroidism and increased adreno-androgenic hormonal secretion. Furthermore, diabetes is also associated with accelerated tooth development. In Cushing's disease and hypophysial nanism are most often presented with disturbances in the sequence of eruption of permanent teeth and the retardation in resorption of the roots of teeth [8]. Another disease which plays a major role in pathological tooth eruption is Rickets disease. In it are found changes in sequence, time, and symmetry of tooth eruption. Pathological tooth eruption is also related to vitamin deficiency, tuberculosis, exudative diathesis and diseases of the stomach and intestines, according to Kotchetova.

**Gender** also determines differences in the eruption of the permanent teeth. Authors who are studying the influence of gender are establishing earlier tooth eruption and a higher volume of erupted teeth in females at 6 to 14 years of age in comparison to males [9]. The biggest difference between the two sexes regarding tooth eruption can be seen in canine teeth – which can occur 4 to 6 months earlier in girls. Earlier tooth eruption in females is associated with their earlier physical development [10]. According to Kotchetova (2009), delayed skeletal maturation and tooth eruption in boys is connected with the expression of genes coded in the Y-chromosome. Gender difference is also presented in the sequence of eruption. For other scholars, the classical sequence of eruption [11], in which firstly mandibular teeth erupt and after them the teeth in the maxilla, is found more often in females than in males [12].

The eruption of the permanent teeth, as an indicator

of the morpho-functional state and biological maturity of children, is closely dependent on their nutrition. The main anthropometric features (height and weight) are used to evaluate physical development and Body Mass Index [13]. Balanced nutrition is important for the development of the maxillo-facial complex in children. The main nutrition groups, that play the biggest role in development and the process of tooth eruption are proteins, vitamins, and minerals. Evidence has been found that shows that the lack or absence of these macro- and micronutrients in food and chronic malnutrition are leading to the retardation of tooth development and eruption, reduction of the size of the teeth and formation tooth decay and periodontal pathology [14]. A number of studies have established a positive relationship between tooth eruption and anthropometric features, such as children who are underweight and stunted height experience retardation in tooth eruption, while heavier and taller children experience faster eruption. Belugina also reports a correlation between anthropometric features and tooth eruption in boys and girls more pronounced at the 5-7 and 12-14 years of age. She associates this relation with the peculiarities of the physical development of children in these age groups when acceleration in growth is present. The correlation between height and dental status in 5-14-year-old children is also studied by Kupryanova [15]. She observes delays in the time of tooth eruption in children with stunted height, body weight deficit or disharmonious physical development. Other authors do not establish a significant correlation between stature and tooth eruption [16]. Shuper A. et al. consider that dentition develops independently from the body and should not be used as a clinical evaluation indicator for physical development [17]. The literature sources show contradictory information towards the correlation between tooth eruption and Body Mass Index, which is widely used to evaluate the degree of overweight, obesity or thinness in children. A number of authors have reported a positive correlation between tooth development in children and their BMI [18]. They establish accelerated tooth development in overweight and obese (high BMI) children, even if sex and age is taken into consideration. Eruption of permanent teeth in these children starts 1.2 to 1.5 years earlier than in children with normal BMI, which is associated with earlier puberty [19]. Studying overweight children in primary school, Sanchez-Perez et al. found that they have more erupted teeth and lower cases of tooth decay index [20]. In contrast, Sabharwal et al. did not find earlier tooth eruption in children with higher a BMI [21].

It should be pointed out that **individual factors** are essential for tooth eruption. Correlations are observed between the features of individual development, constitution, tooth eruption and some anthropometric features, in particular – the morphological height of the face. Tooth eruption plays a major role in the alterations of the facial part of the cranium. Development of the mandible is parallel with the tooth eruption and is directly dependent on it. This process is mostly promened in the periods of the eruption of primary dentition and its change with the permanent dentition. Locally acting factors should also be

taken under consideration. In the case of anomalies of the bite, an earlier eruption of the incisors and first molars occurs and when pathology is not found – the earlier eruption of the canines, premolars and second molars occurs.

The indicators of biological maturity and in particular tooth eruption are significantly influenced by **environmental factors**, such as climate-geographic, socio-economic, ecological, etc. factors [22].

Again, according to Almonaitiene et al. variations of tooth eruption in children are conditioned geographically and are due to changes in nutrition and environmental factors, which could also lead to differences in eruption of the permanent dentition. Specifics in the intensity and sequence of the process of eruption of the permanent teeth are established depending on the type of settlements of residence, such as children who are living in cities have earlier maxillofacial development than ones who are living in small villages. As such, a positive correlation between social status and tooth eruption is presented. Taking under consideration the profession and incomes of the parents, housing conditions, family size and other variables, some authors show earlier tooth eruption in children, who are living in good social conditions compared to ones from lower social strata. Some reasons for this are the optimal healthcare of the children and well-balanced nutrition [23].

Tooth eruption as one of the features of the morpho-functional maturity of children is considered in the context of **secular changes**. In the scientific literature, the changes in the anthropological dimensions of children and adolescents from different generations are most often followed, revealing the specifics of their growth and maturation during different periods of time in different living conditions, but relatively few studies are directed towards dental development and eruption.

Data from multiple comparison analyses of different generations of children show that until the 1980s, acceleration in growth, increase in body size, earlier puberty with retention in acceleration and even deceleration changes are presented [24].

Analysis of secular changes in the dental development of children from different geographical regions shows controversial results. In studies of secular trends in tooth eruption during the last 30 years in Turkish children, no differences in tooth development are observed [25]. However, accelerated changes in the dental development of

Croatian children are registered during a 30 year period (1977-9 and 2007-9) as they are more prominent in girls than in boys [26]. Positive changes for the twenty-year period (1980 – 2000) are also established in 6-8-years-old Finnish children, while in 9-11-years-old, similar changes are not found [27].

Twelve-years-old Turkish girls born during the 1990s and 2000's, have significantly more mature dentition than girls born in the 1980s. Girls generally tend to have more mature dentition than boys.

Some medico-biological factors negatively influence the processes of formation and eruption of teeth in children: the age of the mother and father, bad habits and unfavorable working environment of the parents, problems during the pregnancy, and diseases of the child in the first year of life [28].

In Bulgaria, Peneva's already referred to survey remains with great scientific and practical contribution to this day. The author found accelerated tooth eruption when social conditions improve and a higher number of erupted teeth in taller and heavier children. Furthermore, earlier tooth eruption in girls than in boys is presented, especially during puberty. Peneva, in her previously mentioned research reports earlier eruption in children who are consuming quantities of food in accordance with the requirements of the developing child's organism nutrition. Correlation between tooth eruption and the age of the mother is also established – in children born to younger mothers, the processes of growth and development are faster, and, accordingly, earlier dental eruption is expected. The author presents that deceleration in development, in particular in the process of eruption of the permanent teeth in children with pathological birth, more clearly manifested at an earlier age and with a lower number of erupted permanent teeth in children suffering from Rickets disease.

## CONCLUSION

The process of development of the teeth is conditioned by a number of factors related to the development of a child's organism, such as genetics, socio-economic, etc. The interdisciplinary approach to the analysis and evaluation of these factors will contribute to the preparation and implementation of a prevention and treatment plan by multidisciplinary teams of pediatricians and dentists, collaborating in their efforts to achieve optimal results.

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#### Address for correspondence:

Boyan Kirilov

Department of Anthropology and Anatomy, Institute of Experimental Morphology, Pathology and Anthropology with Museum, Bulgarian Academy of Sciences; Akad. G. Bonchev Str., building 25, 1113 Sofia, Bulgaria.

E-mail: [drkirilov@yandex.com](mailto:drkirilov@yandex.com),