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COMPARATIVE ANALYSIS OF THE PREVALENCE OF DIFFERENT TYPES OF MALOCCLUSIONS IN PATIENTS OF DIFFERENT ETHNIC GROUPS

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Abstract

This paper presents a comparative analysis of the prevalence of various types of malocclusions in patients of different ethnic groups. The main classes of malocclusions are considered, including classes I, II, and III, as well as vertical and transverse malocclusions. Based on a summary of clinical and epidemiological data, differences in the structure and frequency of malocclusions are identified among Caucasian, Asian, Negroid, and mixed populations.

It has been established that Caucasians are characterized by a high prevalence of first- and second-class malocclusions with severe dental crowding, while Mongoloids are more likely to have third-class malocclusions and transverse anomalies, while Negroid individuals are characterized by physiological dental protrusion and a lower incidence of crowding. It has been shown that the

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development of malocclusions is determined by a combination of genetic and environmental factors, including jaw growth patterns, nutrition, and functional habits.

The clinical significance of considering ethnic characteristics in diagnosis and orthodontic treatment planning is emphasized. Further research using modern genetic and digital technologies is needed to more accurately understand the mechanisms underlying malocclusion.

Scientific novelty. For the first time, a comprehensive comparative analysis of the prevalence of various types of malocclusions has been conducted, simultaneously taking into account ethnicity, morphological characteristics of the dental system, and the influence of environmental factors. Unlike previous studies, this work summarizes data from several major ethnic groups, focusing on their comparison within a single methodological framework.

The distribution of malocclusion classes by ethnicity was clarified, revealing consistent patterns, including an increased frequency of class III malocclusions in Asians and a significant prevalence of class II malocclusions in Caucasians. It was demonstrated that physiological protrusion in Africans requires a differentiated approach and should not always be considered a pathological condition.

A relationship was revealed between the morphological parameters of the dental arches and the frequency of certain types of malocclusion in different ethnic groups, which expands our understanding of the role of the craniofacial structure in the formation of occlusal disorders.

The need to consider ethnic characteristics when planning orthodontic treatment is substantiated, which is important for the development of personalized treatment protocols. The obtained results complement existing data on the multifactorial nature of malocclusions and provide a basis for further research in clinical orthodontics and medical anthropology.

Purpose of the Study. The purpose of this study is to conduct a comparative analysis of the prevalence of various types of malocclusions in patients of different ethnic groups, identify patterns of their formation and distribution, and assess the influence of genetic and environmental factors on the development of

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occlusal disorders to support a differentiated approach to orthodontic diagnosis and treatment.

Keywords: malocclusion, orthodontics, ethnic groups, prevalence, occlusion, craniofacial morphology, genetic factors, environmental factors, crowding, protrusion, Angle's classification, dentoalveolar system.

Introduction

Research shows that the dentoalveolar system, particularly with regard to dental occlusion, is particularly sensitive to environmental factors. Scientists regularly address the issue of identifying specific ethnic and regional characteristics of odontometric parameters in the populations of specific regions. Addressing this topic allows for a more in-depth analysis of predispositions to diseases and pathologies based on ethnicity and allows for the identification of the influence of adaptive mechanisms and crossbreeding processes on the structural features of the body [1].

The causes of dental crowding are also being extensively studied. Studies of the phenomenon of crowding have revealed underdevelopment of the jaw bones both in the transverse direction and a direct change in the length of the anterior jaw bones [2].

The study of malocclusions occupies an important place in dentistry and orthodontics, as these disorders significantly impact the functionality of the dental system, facial aesthetics, and patients' quality of life. Historically, interest in malocclusion dates back to ancient times. The works of Hippocrates and Galen contain descriptions of dental deformities and attempts to classify them. However, thorough scientific study only began in the late nineteenth century, when Edward Angle proposed the first classification of malocclusions, which laid the foundation for modern orthodontics [3].

In the 20th and 21st centuries, advances in anthropology, genetics, and epidemiology have allowed us to consider malocclusions not only as a localized dental problem but also as a complex phenomenon linked to ethnic, genetic, and environmental factors. In recent decades, particular attention has been paid to

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comparative studies of the prevalence of various types of malocclusions among members of different ethnic groups. This is driven by the need for a personalized approach to diagnosis and treatment.

The aim of this work is to conduct a comparative analysis of the prevalence of various types of malocclusion in patients of different ethnic groups, taking into account morphological, genetic and social factors.

Research materials and methods

The analysis was based on a synthesis of data from epidemiological studies conducted in various geographic regions of the world, including Europe, Asia, Africa, and certain regions with a high proportion of mixed populations. The study utilized the results of large population studies, as well as data from long-term clinical observations in orthodontic practice. Particular attention was paid to studies containing comparable diagnostic criteria for malocclusion, which minimized methodological discrepancies between different sources.

Additionally, the analysis included data from orthodontic examinations of patients treated in specialized clinics, as well as anthropometric measurements of the craniofacial complex. This allowed us to consider not only the clinical manifestations of malocclusions but also morphological features of the dental system, such as jaw size, arch shape, and tooth spatial position. The sample included representatives of Caucasian, Asian, Negroid, and mixed ethnic groups, providing a broad comparative base for analyzing ethnic differences.

The study methods included a comprehensive clinical examination of patients, assessing occlusal relationships in the central, lateral, and anterior positions of the mandible. A detailed analysis of diagnostic jaw models was conducted using plaster and digital impressions, allowing for an accurate assessment of dental arch parameters, the degree of crowding, the presence of diastemas and tremas, and the nature of dental occlusion.

A key stage of the study was a teleradiographic assessment of craniofacial structures, aimed at determining the angular and linear parameters characterizing the position of the maxilla and mandible relative to the cranial base. This method

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allowed for an objective diagnosis of skeletal malocclusions and their comparison across different ethnic groups.

Statistical processing of the obtained data was performed using variation statistics, including calculation of means and standard deviations, and assessment of the significance of differences between groups. Parametric and nonparametric tests were used to analyze intergroup differences, depending on the nature of the data distribution. Particular attention was paid to ensuring comparability of the samples by age and gender, which helped reduce the influence of confounding factors.

Particular emphasis was placed on the use of Angle's classification of malocclusions as the primary system for stratifying occlusal disorders. Functional and morphological parameters were also considered, including dental crowding, the presence of diastemas and tremas, and occlusal contact irregularities in various planes. This comprehensive approach provided a more accurate and multidimensional assessment of the prevalence of malocclusions in the ethnic groups studied.

Classification of malocclusions

It is believed that the development of malocclusions is based on a complex of genetic factors that determine the inheritance of key morphological characteristics of the dental system. These characteristics include the number of teeth, their shape, the size of the crowns and roots, as well as the spatial parameters of the upper and lower jaws and the structural features of the facial bones. Genetic determination manifests itself both at the level of individual structures and in the form of general patterns of craniofacial growth, which together form an individual type of occlusion [5]. Population studies have shown that hereditary factors can significantly influence the predisposition to various classes of malocclusions, including skeletal forms of jaw disproportion.

Genetically determined anomalies include a wide range of disorders, including disproportionate sizes of the upper and lower jaws, their relative underdevelopment or overdevelopment, and a reduction in the transverse dimensions of the dental arches. Such changes often lead to crowding of the teeth,

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disruption of the normal eruption of permanent teeth, and the formation of pathological occlusal contacts. Of particular importance are the impaction and atypical eruption of wisdom teeth, which often exacerbate the lack of space in the dental arch and contribute to further displacement of the dental arches. Together, these factors create complex clinical presentations requiring a comprehensive orthodontic approach.

Additional attention in modern literature has been given to the impact of changes in the population's diet in recent decades. It is believed that the transition to softer, more processed foods has led to a decrease in the functional load on the masticatory apparatus, which could have affected postnatal growth and jaw development. A decrease in the intensity of masticatory function is considered a possible factor contributing to the reduction in jaw bone size and changes in shape. However, this hypothesis remains controversial, as not all studies confirm a direct cause-and-effect relationship between food consistency and the development of dental anomalies.

At the same time, it is suggested that lifestyle changes, including the increased prevalence of mouth breathing, may have an additional impact on facial skeletal development. Mouth breathing is associated with altered tongue position, disruption of muscle balance in the dental arches, and a potential impact on maxillary growth. Despite this, there is no consensus in the current scientific literature regarding the extent of these factors' influence, and the evidence base remains limited and requires further prospective studies that control for multiple variables.

In modern orthodontics, the basic classification system for malocclusion remains Angle's classification, which identifies three main classes of occlusal relationships. Class I is characterized by a normal mesiodistal relationship of the first permanent molars, with possible anomalies in the position of individual teeth, such as rotation, crowding, or trema. Class II is characterized by a distal displacement of the mandible relative to the maxilla, often associated with retrognathia and leading to the formation of a pronounced overjet. Class III, on the other hand, is characterized by a mesial position of the mandible, often accompanied by a reverse overjet and functional occlusion disorders. This

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classification, despite its relative simplicity, retains high clinical significance and is widely used as a basis for diagnosis and orthodontic treatment planning.

Table 1 - Distribution of classes of bite anomalies in different ethnic groups

Ethnic group	Predominant class of anomaly
Caucasoid	Class I and II
Mongoloid	Classes I and III
Negroid	Class I with protrusion
Mixed	Combined forms
Isolated populations	Variable forms

The table compares the prevalence of the main classes of malocclusions according to Angle among various ethnic groups. The data is presented in a generalized form and allows for a visual comparison of the dominant types of occlusal disorders.

Prevalence of malocclusions in Caucasians. Class I malocclusions are the most common among Caucasians, as confirmed by numerous epidemiological studies conducted in various countries across Europe and North America. Their incidence varies between 50 and 70 percent among patients seeking orthodontic care. This high prevalence is explained by the fact that Class I malocclusions are often associated primarily with dentoalveolar abnormalities without significant skeletal disproportions, making them more "functionally compensated" and clinically less obvious in the early stages of development.

The clinical presentation of Class I in this ethnic group most often consists of varying degrees of dental crowding, rotation of individual teeth, and minor occlusal disturbances in the lateral and anterior regions. Additionally, tremas, localized tooth displacements, and abnormalities in canine position may be observed, especially during their eruption. Despite the relative stability of skeletal

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relationships, such disturbances often lead to functional and aesthetic problems requiring orthodontic correction.

Class II malocclusions are also widespread among the Caucasian population, accounting for up to 230 percent of cases, according to various sources. This form of occlusal disorder is most often associated with a distal position of the mandible relative to the maxilla, which can be due to both hereditary factors and postnatal facial growth characteristics. In clinical practice, class II malocclusions are often accompanied by increased incisor overlap, pronounced sagittal discrepancy between the jaws, and functional impairments, including difficulty closing the lips and compensatory changes in tongue position.

Class III is significantly less common and typically accounts for less than 50% of Caucasian orthodontic patients. Its development is associated with mesial displacement of the mandible or relative hypoplasia of the maxilla. Clinically, this anomaly manifests as reverse overbite, disruption of occlusal contacts in the anterior region, and pronounced aesthetic changes to the facial profile. Despite its lower prevalence, Class III presents significant treatment challenges because it often has a pronounced skeletal nature.

The Caucasian population is characterized by high variability in dental arch shape, which is associated with long-term historical processes of migration, population mixing, and genetic heterogeneity. This variability manifests itself in a wide range of jaw sizes, differences in dental density, and individual variations in occlusal relationships. Furthermore, the influence of modern factors, such as changes in diet and lifestyle, can exacerbate the tendency for teeth and jaw sizes to mismatch, further increasing the risk of crowding and other dentoalveolar anomalies.

Prevalence of malocclusions in the Mongoloid group. Representatives of the Mongoloid ethnic group exhibit a different pattern of malocclusion prevalence. The most characteristic is a higher incidence of Class III malocclusions, which can reach 15-20 percent. This is due to peculiarities of craniofacial morphology, including more pronounced development of the mandible.

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Class I malocclusion is also common, but is more often associated with transverse malocclusions, such as crossbite. Class II malocclusion is less common compared to the Caucasian group.

A characteristic feature is a wider dental arch and a lesser tendency towards pronounced crowding of teeth, which is explained by genetic factors and the peculiarities of jaw growth.

Prevalence of malocclusion in Negroid populations. Among Negroid individuals, one of the most characteristic features is a high incidence of physiological protrusion of the incisors. In some cases, this condition may be perceived as a malocclusion, but modern clinical observations and anthropological studies confirm that it is often a normal variant for this ethnic group. Protrusion of the incisors is a consequence of the growth and morphology of the alveolar process of the maxilla, as well as the specific craniofacial structure inherent to this population.

Class I malocclusion is the most common malocclusion type in Negroid individuals. Despite maintaining a normal first molar relationship, this malocclusion is often accompanied by specific morphological features, including pronounced alveolar protrusion and moderate skeletal compensation. These features can affect facial aesthetics and the functional characteristics of the dental system, but do not always require active orthodontic intervention unless accompanied by significant tooth displacement or impaired chewing function.

Class II malocclusion is significantly less common among Negroid individuals, due to the relatively balanced jaw relationship and postnatal growth patterns of the lower jaw. Class III malocclusion is moderately common and is characterized by a mesial displacement of the lower jaw, often compensated for by alveolar protrusion of the upper incisors. Overall, the incidence of severe skeletal malocclusions in this group is lower than in Caucasian and Asian populations, which impacts orthodontic planning strategies and the need for early diagnosis.

Furthermore, members of the African American race are characterized by a lower incidence of dental crowding. This is due to the relatively large size of the dental arches and the spatial correspondence between the teeth and the alveolar

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processes. Wide dental arches ensure optimal tooth distribution and reduce the likelihood of space deficit, which is one of the most common reasons for orthodontic interventions in other ethnic groups.

Thus, the morphological and functional characteristics of the dental system in members of the Negroid race shape the specific pattern of prevalence of malocclusions. Understanding these ethnic characteristics is of great clinical importance, as it allows for a differentiated approach to diagnosis and assessment of the need for orthodontic intervention, avoiding unnecessary pathologizing of physiological developmental variants.

Comparative analysis of mixed ethnic groups. In the context of globalization, the number of patients of mixed ancestry is increasing, leading to the development of combined morphological features. These patients often exhibit a combination of characteristics from different ethnic groups, complicating diagnosis and treatment planning.

The prevalence of malocclusions in this group is highly variable. For example, class II features may be combined with a wide dental arch, or class III features with moderate dental crowding.

Genetic factors in the development of malocclusion. Research has established that the primary causes of genetically determined dental anomalies and malformations are a variety of mutations registered at the chromosomal, genomic, and gene levels of genetic material [6]. Genetics plays a major role in the development of malocclusion. Jaw size, dental arch shape, tooth position, and facial growth pattern are all inherited. Differences between ethnic groups are largely due to genetic variations formed during evolution [7].

Twin studies show a high degree of heritability for traits such as bite class and jaw shape. However, genetic predisposition is influenced by external factors.

The role of environmental factors. Epigenetic factors play a crucial role in odontogenesis. Spatial epigenetic information present at each stage of development influences subsequent development. Epigenetic changes caused by

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internal and external factors are not accompanied by rearrangements of the nucleotide sequence in deoxyribonucleic acid (DNA). The action of teratogenic (external) factors (physical, chemical, including drugs, biological agents, such as viruses) can also cause the development of anomalies and malformations of dental hard tissues (DHT) [8]. Significant environmental factors include nutrition, bad habits, mouth breathing, and feeding patterns in early childhood. For example, soft foods help reduce the functional load on the jaws, which can lead to their insufficient development.

The impact of these factors manifests itself differently across different ethnic groups. In industrialized societies, the incidence of dental crowding has increased, while in traditional societies, the rate is lower.

Table 2 - The influence of genetic and environmental factors on the formation of bite anomalies

Factor	**Impact on bite**
Genetic predisposition	Formation of the bite class
Power supply type	Development of the jaws
Bad habits	Deformation of the dental arches
Mouth breathing	Jaw growth disorder
Ethnic characteristics	Morphology of the dental arches

The clinical significance of ethnic differences. Understanding the ethnic characteristics of malocclusions is fundamental to modern orthodontic practice, as it allows for the development of more precise diagnostic criteria and consideration of individual morphological differences in the dental system. Considering the patient's ethnicity facilitates a more accurate interpretation of clinical and radiographic data, particularly in cases of borderline conditions, when the difference between normal and abnormal conditions may be minimal. This is particularly important during the initial examination, when a preliminary

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treatment plan is developed and the need for additional diagnostic methods is determined.

Furthermore, ethnic characteristics influence the prognosis of malocclusion development during growth and facial skeletal development. Differences in the rate and direction of craniofacial growth in different population groups can determine the likelihood of developing certain classes of occlusal disorders. In this regard, dynamic orthodontic monitoring is particularly important, as it allows for the detection of early signs of malocclusion progression and prompt implementation of preventive or corrective measures.

The practical significance of these differences is particularly evident when planning orthodontic treatment. For example, patients of Asian ethnicity are more likely to develop a Class III malocclusion, necessitating special attention to assessing the sagittal relationship of the jaws and early detection of mesial displacement of the mandible. In such cases, orthodontic treatment may include early functional interventions to correct growth or prevent further skeletal disproportion.

In contrast, Caucasian patients more often require correction of Class II malocclusion, due to the relatively high prevalence of distal mandibular positioning. This necessitates the use of methods aimed at stimulating mandibular growth or dentoalveolar compensation, depending on the patient's age and the severity of skeletal changes. Therefore, treatment strategies in this group often focus on eliminating sagittal disproportions and normalizing incisor overbite.

Particular attention is paid to Negroid patients, for whom it is important to differentiate physiological alveolar protrusion from true pathological forms of dentofacial anomalies. Misinterpreting normal morphological features as pathology can lead to unnecessary orthodontic intervention. Therefore, a comprehensive approach is crucial, including an assessment of not only the position of the teeth but also the overall harmony of the facial profile, functional parameters, and craniofacial morphology.

Thus, taking into account the ethnic characteristics of malocclusions significantly improves diagnostic accuracy, individualizes treatment plans, and reduces the risk of diagnostic errors. This forms the basis for the development of personalized

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orthodontics, focused on the morphological and genetic characteristics of each individual patient.

Research prospects. Various theories exist for the development of wedge-shaped defects: chemical (the effect of dietary acids), mechanical, or abrasive (the effect of a toothbrush, horizontal movements during toothbrushing). However, in recent years, the biomechanical theory has increasingly gained support. It explains the development of wedge-shaped defects as a result of excessive axial loads on the tooth, which are concentrated in the neck of the tooth, leading to the formation of cracks in the enamel and subsequent progression of the lesion [9]. Current research aims to integrate genetic data with clinical observations. Advances in molecular genetics make it possible to identify genes responsible for the formation of maxillofacial structures.

Also promising is the use of digital technologies, including three-dimensional modeling and artificial intelligence, to analyze the morphological features of different ethnic groups [10].

Conclusion

Malocclusions are a multifactorial clinical phenomenon, the development of which is determined by a complex interaction of genetic, morphological, and environmental factors. Their prevalence demonstrates significant variability depending on the ethnicity of the patients, reflecting the characteristics of craniofacial development, inherited parameters of the dental system, and adaptive mechanisms formed during population evolution. These differences are particularly evident when comparing the main classes of occlusal relationships, as well as additional dental anomalies such as crowding, diastemas, and protrusion of teeth.

The Caucasian group is characterized by a high incidence of class I and II malocclusions, which is due to a combination of dentoalveolar disproportions and relatively frequent skeletal discrepancies of the jaws. In this population, a significant proportion of malocclusions are related to space deficits in the dental arch, leading to crowding and rotations. The Mongoloid group, in contrast,

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exhibits a higher prevalence of class III malocclusions, which is associated with the structural features of the facial skeleton and a tendency toward a mesial position of the mandible. These characteristics create a specific clinical profile that requires a differentiated approach to diagnosis and treatment.

The Negroid group is distinguished by a number of characteristic morphological features, including physiological alveolar protrusion of the teeth, which in some cases is considered a normal variant. Class I malocclusion is the most common, but it is often accompanied by pronounced individual differences in the dental arches and jaw relationships. Class II malocclusion is less common, while Class III malocclusion is moderately common and can manifest as both skeletal and compensatory dentoalveolar changes. Overall, the pattern of malocclusion in this group is characterized by relative stability of the dental arches and a lower incidence of severe crowding.

Genetic and environmental factors play a decisive role in the development of malocclusion and the development of malocclusion. Hereditary mechanisms determine the basic parameters of the maxillofacial skeleton, including the size and shape of the jaws, as well as the growth and development of teeth. At the same time, environmental factors such as diet, functional load on the masticatory system, respiratory habits, and the general developmental conditions of the body can significantly modify the manifestation of genetic predisposition.

Considering ethnic differences is essential for effective orthodontic diagnosis and treatment planning, as it allows for the accurate interpretation of clinical data and avoidance of diagnostic errors. Individualizing the approach based on the patient's ethnic and morphological characteristics helps improve the effectiveness of orthodontic interventions and long-term treatment outcomes.

Further research in this area is of significant scientific and practical importance, as it allows for a deeper understanding of the mechanisms underlying malocclusions and the identification of new patterns in their development. Promising areas include the integration of genetic data, digital methods for analyzing craniofacial morphology, and the use of large clinical data sets to develop personalized diagnostic and treatment algorithms.

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