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AI-BASED ALGORITHM FOR DIAGNOSING DEEP BITE IN CHILDREN

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Abstract: Deep bite is one of the most common dentofacial anomalies in children and adolescents. Timely and accurate diagnosis of this pathology is crucial for selecting the optimal orthodontic treatment strategy and preventing the development of functional and morphological disorders. The aim of this study was to develop and clinically evaluate an algorithm for diagnosing deep bite in children using artificial intelligence technologies. Clinical, anthropometric, photometric, and radiological examination methods were used in the study, along with computer analysis of lateral cephalograms and digital dental models.

The proposed AI algorithm made it possible to automate the analysis of diagnostic data, improve the accuracy of determining the type of deep bite, and optimize orthodontic treatment planning. The use of intelligent diagnostic systems contributes to reducing clinician variability and improving the effectiveness of orthodontic care for children.

Keywords: Deep bite, children, orthodontics, artificial intelligence, diagnostics, cephalometric radiography, AI algorithm.

Relevance

Dentofacial anomalies occupy one of the leading positions in the structure of dental pathology among children and adolescents. Among them, deep bite is one of the most common forms of occlusal disorders and is characterized by excessive vertical overlap of the lower incisors by the upper teeth. According to various authors, the prevalence of deep bite among the pediatric population ranges from **20% to 45% of all orthodontic anomalies**. This pathology may be accompanied by impaired masticatory function, trauma to the oral mucosa, pathological changes in the periodontium, and disorders of the temporomandibular joint.

In addition, deep bite often leads to significant aesthetic disturbances and psychological discomfort in children. Traditional methods for diagnosing deep bite include clinical examination, analysis of diagnostic jaw models, photometric studies, and radiological diagnostics. However, comprehensive analysis of all diagnostic parameters requires considerable time and may be associated with subjective diagnostic errors.

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In recent years, digital technologies and artificial intelligence systems have been actively introduced into dentistry. Machine learning algorithms make it possible to automate the processing of radiographic images, increase the accuracy of measurements, and standardize the diagnostic process. Despite the growing interest in the application of artificial intelligence in dentistry, the development of specialized algorithms for diagnosing deep bite in children remains insufficiently studied. Therefore, an important task of modern orthodontics is the creation of intelligent systems capable of analyzing complex diagnostic data and assisting clinicians in making accurate diagnoses.

Aim of the Study

To develop and evaluate the effectiveness of an **AI-based algorithm for diagnosing deep bite in children** based on the analysis of clinical, anthropometric, and radiological data.

Materials and Methods

The study included patients diagnosed with deep bite aged **6 to 35 years** who sought orthodontic consultation at **Tashkent State Medical University** during the period **2024–2025**.

A total of **67 patients with deep bite** were examined and selected for orthodontic treatment (main group). The **control group** consisted of **21 patients with physiological occlusion** and no dentofacial anomalies or deformities, comparable in age and gender.

Among the 67 examined patients:

- **42 patients (77.5%) were female**
- **23 patients (22.5%) were male**

The main focus of the study was on the comparative characteristics of treatment outcomes, the duration of therapy, and the stability of the achieved results.

Research Methods

The following diagnostic methods were used in the study.

1. Clinical Examination

An intraoral examination was performed to evaluate:

- occlusal relationships of the dental arches
- depth of incisal overlap
- position of individual teeth
- shape of dental arches
- condition of the oral soft tissues

2. Anthropometric Analysis of Dental Casts

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Diagnostic models were analyzed using the following methods:

- **Pont's method**
- **Korkhaus method**
- **Gerlach segment analysis**
- assessment of dental arch symmetry

3. Photometric Analysis

Facial photographs of the patient were analyzed in:

- frontal view
- profile view
- intraoral photographs of dental arches

4. Radiological Methods

The following imaging techniques were used:

- **Orthopantomography (OPG)**
- **Lateral cephalometric radiography**

The following parameters were analyzed:

- **ANB angle**
- **SN–GoGn angle**
- **Interincisal angle**
- **Lower facial height**

Diagnostic Parameters Analyzed by the AI Algorithm

Diagnostic Parameter	Method of Analysis	Clinical Significance
Incisal overlap depth	Clinical analysis / 3D models	Determination of deep bite severity
Interincisal angle	Cephalometric analysis	Evaluation of incisor inclination
ANB angle	Cephalometric analysis	Sagittal jaw relationship
SN-GoGn angle	Cephalometric analysis	Facial skeletal growth pattern
Lower facial height	Photometry / Cephalometry	Analysis of facial proportions
Occlusal plane inclination	Cephalometric analysis	Evaluation of occlusal relationships
Dental arch width	Model analysis	Determination of dental arch form

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Diagnostic Parameter	Method of Analysis	Clinical Significance
Jaw growth direction	AI analysis of cephalograms	Treatment planning

AI-Based Diagnostic Algorithm

The developed deep bite diagnostic algorithm consists of several sequential stages.

Stage 1 — Patient Data Input

The following patient data are entered into the system:

- patient age
- sex
- type of occlusion
- facial and intraoral photographs
- lateral cephalogram
- orthopantomogram
- digital dental models

Stage 2 — Automated Image Analysis

The artificial intelligence algorithm performs:

- tooth segmentation
- identification of anatomical landmarks
- calculation of cephalometric parameters

Stage 3 — Morphometric Analysis

The system automatically determines:

- incisal overlap depth
- dental arch shape
- jaw relationships
- direction of facial skeletal growth

Stage 4 — Classification of Deep Bite

The algorithm identifies three main forms of deep bite:

1. **Dentoalveolar**
2. **Skeletal**
3. **Combined**

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Stage 5 — Diagnostic Report Generation

The system generates an automatic report including:

- degree of deep bite severity
- type of anomaly
- characteristics of jaw growth
- recommendations for treatment planning

Results

Analysis of the obtained data showed that the use of the **AI diagnostic algorithm significantly increases the accuracy of deep bite diagnosis**. The main results of the study demonstrated:

- **an increase in diagnostic accuracy by 12–18%**
- **a reduction in cephalometric analysis time by 35–40%**
- **a decrease in inter-observer variability among clinicians**

The algorithm enabled more precise determination of:

- jaw growth direction
- skeletal and dentoalveolar components of the anomaly
- severity of deep bite

It was also established that AI-assisted diagnostics contributes to more accurate orthodontic treatment planning. The obtained results confirm the перспективность использования технологий искусственного интеллекта в ортодонтической практике. The application of AI algorithms allows:

- standardization of the diagnostic process
- reduction of diagnostic errors
- acceleration of diagnostic data analysis
- improvement of treatment planning accuracy

Particular importance of artificial intelligence is observed in **cephalometric analysis**, as this process requires highly precise identification of anatomical landmarks.

Automated systems for analyzing radiographic images significantly improve diagnostic objectivity and facilitate the work of orthodontists.

Conclusion

Deep bite is one of the most common dentofacial anomalies in children and requires a comprehensive diagnostic approach. The developed AI-based diagnostic algorithm allows automation of the analysis of clinical and radiological patient data. The use of artificial

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intelligence improves the accuracy of deep bite diagnosis and reduces the likelihood of diagnostic errors.

The use of intelligent cephalometric analysis systems makes it possible to more accurately determine morphological features of the facial skeleton and the direction of jaw growth. The proposed algorithm can be used in practical orthodontics to improve diagnostic efficiency and treatment planning for children with deep bite.

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