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Anthropometric Analysis of Digital Models of the Dentition Using 3D Technologies in Orthodontics

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

The development of modern computer technologies has made it possible to introduce into orthodontic practice the latest methods of diagnosis and treatment of dentoalveolar anomalies. Domestic orthodontics, which has an extensive scientific base, has received the opportunity for technological development since the beginning of the 90s. The Department of Orthodontics Moscow State University of Medicine and Dentistry named after A.I. Evdokimov of the Ministry of Health of Russia (Moscow, Russia), throughout its scientific experience, under the guidance of Corresponding Member of the Russian Academy of Medical Sciences, Doctor of Medical Sciences, Professor L.S. Persina, uses modern diagnostic methods in her diagnostic arsenal to analyze the morphological state of the dentition.

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Keywords: 3D technologies; orthodontics; digital models; anthropometric analysis.

1. INTRODUCTION

The development of modern computer technologies has made it possible to introduce the latest methods of diagnosis and treatment of dental anomalies into orthodontic practice [1-4]. Russian orthodontics, which has an extensive scientific base, has been able to develop technologically since the early 90s. The Department of Orthodontics Moscow State University of Medicine and Dentistry named after A. I. Evdokimov of the Ministry of Health of Russia (Moscow, Russia) throughout its' scientific experience, under the guidance of a Corresponding Member of the Russian Academy of Medical Sciences, MD, Professor L. S. Persina, uses modern diagnostic methods in her diagnostic arsenal in order to analyze the morphological state of the dental system. Anthropometric analysis of diagnostic models of dentition is one of the main diagnostic methods in orthodontics [5-7]. Previously, the analysis was carried out using a caliper and a ruler, which did not always exclude metric errors. The development of modern technologies opens up opportunities for a more accurate analysis of the studied material and diagnostic models in particular [8-13]. Modern computer programs and innovative tools used allow combining digital 3D diagnostic models with photographs, and this allows discussing the treatment plan and the results of orthodontic treatment with the patient with a demonstration of the clinical picture on the monitor screen [14-19]. Accordingly, the accuracy of measurements has increased and the prognosis of orthodontic treatment has become sufficiently predictable [20,21].

1.1 Purpose of the Article

Analysis of the use of modern computer programs in orthodontic practice in the examination of a patient with occlusion anomalies.

1.2 Objectives

1. Application of modern computer programs in the study and analysis of digital diagnostic models.
2. Determination of the stages of manufacturing digital diagnostic models of dentition.
3. Conduction of an anthropometric analysis of digital diagnostic models of dentition with the help of innovative tools.

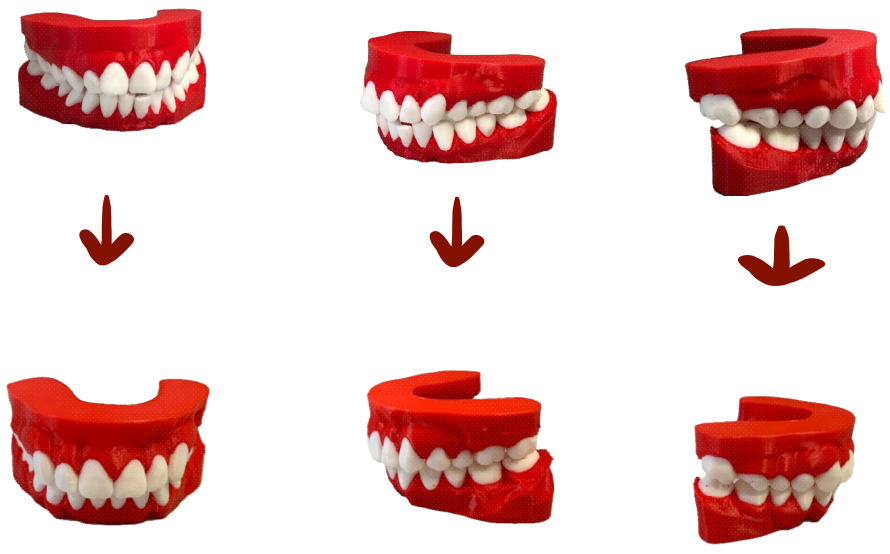

Fig. 1. Diagnostic models made using 3D printing

2. MATERIALS AND METHODS

The modern computer programs of domestic and foreign manufacturers are used. An anthropometric analysis of 10 virtual diagnostic models of dentition with anomalies of the position of the teeth was carried out. Digital diagnostic models were made on the basis of dental impressions obtained by a doctor and further scanning of plaster models of dental rows. Digital diagnostic models were studied by dividing the tooth rows into segments: anterior (upper, lower), lateral right and left (upper and lower), respectively (Fig. 1). 20 anterior and 40 lateral segments were determined and studied on digital diagnostic models. Mesiodistal, mediolateral dimensions of teeth, transversal, sagittal dimensions of tooth rows and apical bases were measured and studied. The measurement results are analyzed. The analysis of occlusiograms obtained at the diagnostic stage was carried out.

3. RESULTS AND DISCUSSION

The results of the anthropometric analysis in the examined group showed that the size of the incisors of the upper dentition was increased and their position was characterized as crowded due to an increase in mediolateral dimensions, which was 40%. Narrowing of the dentition was observed in 45% and, as a result, there was a close position of the teeth. Shortening of the dentition was diagnosed in 15%, which is due to the early loss of baby teeth(from the anamnesis), secondary adentia of permanent teeth, and consequently the displacement of the mesial chewing group of teeth (Fig. 2). The influence of the position of the teeth on the degree of chewing load is determined, which is proved by occlusiograms.

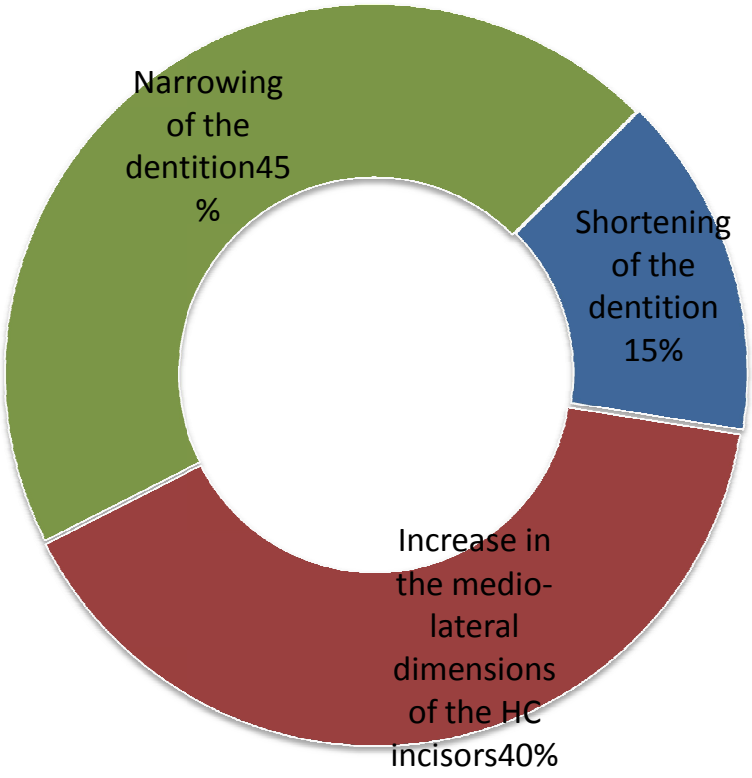

Fig. 2. Results of the anthropometric analysis of 3D models

4. CONCLUSION

The use of modern computer technologies accelerates the diagnostic process, allows for high-precision anthropometric analysis of digital diagnostic models, and systematizes the received diagnostic information. It also gives the doctor a more detailed diagnosis, which speeds up and facilitates the treatment plan. Modern digital and additive technologies allow the patient to look at the treatment plan, before and after.

Computer technologies allow us to:

- to increase the accuracy of measurements, and therefore to make an accurate diagnosis and predict the results of orthodontic treatment

- simulate the shape and size of the dentition, create occlusal relationships on virtual diagnostic models obtained on the basis of an impression with subsequent scanning of plaster models or obtained using intra-oral scanners that scan the oral cavity with high accuracy.

- modules of modern computer programs allow doctors to use virtual models of dentition at the diagnostic stage

CONSENT

It is not applicable.

ETHICAL APPROVAL

Agreements were obtained to participate in patient trials. Ethics committee approved the obtained data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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