IJACT, Volume 2, Issue 9, 2024 ISSN: 2995-5378
http://medicaljournals.eu/index.php/IJACT

INTERNATIONAL JOURNAL OF ALTERNATIVE AND CONTEMPORARY THERAPY

Comparative Evaluation of the Measurement of Cephalometric Parameters

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Abstract: The article explores the features of the integration of modern digital and computer technologies in the diagnosis process of patients with orthodontic profile. The materials of a number of scientific publications and articles devoted to cephalometric analysis are considered to improve the accuracy and quality of diagnostic capabilities. The cephalometric parameters of the patients are analyzed, analyzed by a number of possible methods. During the study, patients were diagnosed and data were obtained characterizing the features of using standard and proposed methods of analysis.

Keywords: cephalometry, orthodontic treatment, diagnosis, dentofacial anomalies.

Introduction: Cephalometric examination is included in the complex of mandatory diagnostic measures for the examination of patients with maxillofacial abnormalities. Cephalometric data give an idea of the characteristics of the cerebral and facial parts of the human skull, their mutual ratio in the absence and in the presence of dental anomalies. This method is informative, does not require the use of expensive tools, can be applied in people of all age groups not only during clinical examination, but also in as a screening method for mass preventive examinations. Data on the size and features of the cerebral and facial parts of the human skull contribute to the early detection of dental anomalies, as well as allow us to determine the cause of their development, predict the degree of change in cephalometric parameters after completion of treatment.

The lack of consensus on the presence or absence of a relationship between the indicators of the cerebral and facial parts of the skull, as well as on the features of cephalometric characteristics in various types of anomalies of the ratio of dental arches in humans determines the relevance of studying these issues. Such information can be widely used in orthodontics, maxillofacial surgery as diagnostic criteria and prognostic signs in the complex treatment of maxillofacial anomalies.

Modern dentistry is characterized by an aesthetic orientation of development, which is due to the increased demands of a person on his own appearance. Orthodontic treatment is inextricably linked with the processes of harmonization of the patient's appearance. It is known that anomalies in the ratio of dentition are accompanied by changes in the bone structures of the skull, which leads to violations of the proportions of the face and the proportionality of its parameters. In this regard, it is of interest to study the facial parameters of patients during the initial examination for drawing up a treatment plan and monitoring their changes as a result of it.

Until now, measurements carried out clinically or using photo analysis could be used for cephalometric analysis of facial parameters. The clinical method of cephalometric measurements is technically difficult to perform, takes a lot of time for both the doctor and the patient, and requires special measuring instruments. Photo analysis of cephalometric parameters is a more ergonomic and modern way, however, photography does not convey the three-dimensional parameters of the measuring object, which affects the accuracy of this method.

The development of digital technologies makes it available today to use a volumetric model of the patient's face for cephalometric analysis, which can increase the accuracy of calculations and make this procedure comfortable for the doctor and the patient.

The purpose of the study is to compare the accuracy of various methods of cephalometric measurements.

Research objectives:

1. To determine the structure of dental anomalies in the examined group of patients

2. To measure facial parameters in a group of patients with dental anomalies in three different ways (clinical, photometric, using a volumetric model of the face);

3. Determine the accuracy of measurement methods using parametric analysis, evaluate the results.

Materials and methods: 28 patients aged 14-18 years (average age 22+- 1.3) with various dental anomalies were examined. The following cephalometric parameters were determined: face width (ZF-ZF), face height (hairline-Me) and height of the third face (hairline-N, N-sn, sn-Me). The measurements were carried out in three ways: clinically (using a ruler and a caliper), photometric (full-face and profile photos on a lined background) and using face scanning (3D Beauty mobile application).

The research materials were subjected to statistical processing using parametric analysis methods. Accumulation, correction, systematization of initial information and visualization of the results were carried out in Microsoft Office Excel 2016 spreadsheets. The statistical analysis was carried out using the STATISTICA 13.3 program

Results:

In the structure of the distribution of dental anomalies in the examined patients, anomalies of the first class according to Engl's classification were determined in 35% of cases, of the second class in 44%, and of the third class in 21%.

Vertical malocclusion such as: deep incisor occlusion, deep traumatic occlusion, vertical dysocclusion in the frontal region were observed in 37%, 7% and 12%, respectively. Crowding of teeth was determined in 65% of cases.

The analysis of the cephalometric parameters showed the following picture: the measurements carried out in a clinical manner are the most accurate, since there are no program distortions, therefore they were legitimately taken for the standard. However, this process requires considerable time and special skills from the doctor, on average, measuring one patient takes 15 minutes.

Before carrying out photometric measurements of the studied parameters, all photos were scaled using a graphical editor. Each parameter was measured using an electronic ruler. The average time to take photos and analyze the data of one patient was 25 minutes.

For the analysis of 3D models, scans of the face were obtained using a mobile device and the 3D Beauty program (the average study time is 2 minutes), calculations were obtained automatically.

Quantitative indicators of cephalometric parameters were evaluated for compliance with the normal distribution, the Shapiro-Wilk criterion was used for this (with the number of subjects less than 50).

Quantitative indicators had a normal distribution, the data obtained were combined into variational series, in which arithmetic averages were calculated. When comparing the average values in

The Student's t-test was calculated on normally distributed sets of quantitative data. The obtained values of the Student's t-test were evaluated by comparing them with critical values. The differences in the indicators were considered statistically significant at the level of $p<0.05$.

Checking the equality of two measurement results using mathematical statistics using the Student's t-test also leads in this case to the conclusion that the results are equal, i.e. there are no statistically significant differences in three parameters (p from 0.79 to 0.97).

However, comparing the average values of the parameters of all three measurement methods, we see that the average values of the samples fall into the general confidence interval. There is reason to

believe that the average values of different samples belong to the same general population and have points of contact. The more intersection points the parameters have, the more identical they are.

The parameters determined clinically and the parameters obtained by analyzing the volumetric model have two points of coincidence, which proves the accuracy of the studied technique.

1. Measuring facial parameters in a clinical way is, in our opinion, the most accurate, but it takes a long time and requires special skills from a doctor. Measurements obtained using a digital ruler based on a photo of a face have a large error in comparison with measurements using a mobile device and the 3D Beauty program.

2. This study demonstrates the possibility of using facial scanning of patients and using a 3D model for cephalometric analysis at the stages of diagnosis and orthodontic treatment.

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