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EFFICIENCY OF COMPUTER MODELING WITH ORTHO ANALYZER SORTWARE PROGRAM IN THE TREATMENT PROTOCOL OF CHILDREN WITH CLEFT LIP AND PALATE

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Objective:
The overall prevalence of OFC is estimated to be approximately 1 in 700 live births, accounting for nearly one half of all craniofacial anomalies [7, 8, 9]. As reported by the World Health Organization (WHO), the prevalence at birth of OFC varies worldwide, ranging 3.4–22.9 per 10,000 births for CL/P, and 1.3–25.3 per 10,000 births for CPO [8]. The incidence of CL/P and CPO can vary greatly between studies.
The article presents the possibilities of virtual planning of complex treatment of children with CCLP in the neonatal period using the Ortho Analyzer visual planning software.
Using the methods of computer diagnostics and modeling in a modern healthcare system will allow to obtain the most accurate data on the status of the maxillo facial area of patients with cleft lip and palate. Accuracy of the data obtained during the planning of the primary surgical stage of treatment of children with CCLP allows the most accurate assessment of the position and angle of the fragments of the alveolar processes of the upper jaw for treatment planning, taking into account the individual features of the anatomical structure of the jaw bones of each patient with the CCLP.
Key words: *cleft lip and palate, rehabilitation, computer diagnostics*

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INTRODUCTION:

The overall prevalence of OFC is estimated to be approximately 1 in 700 live births, accounting for nearly one half of all craniofacial anomalies. As reported by the World Health Organization (WHO), the prevalence at birth of OFC varies worldwide, ranging 3.4–22.9 per 10,000 births for CL/P, and 1.3–25.3 per 10,000 births for CPO [7, 8, 9].

has been found to vary based on ancestry, with the highest incidence rates observed amongst Asian populations (0.82–4.04 per 1000 live births), intermediate rates amongst Caucasians (0.9–2.69 per 1000 live births), and the lowest rates amongst African populations (0.18–1.67 per 1000 live births). Prevalence has also been found to vary further by subgroup, for example, with one study reporting lower rates of OFC amongst Far East Asians compared to Filipinos [1, 9, 5]

One of the problems of a paramount importance in modern healthcare structure is the development and improvement of methods for early rehabilitation of children with congenital abnormalities of the maxillofacial area.

Congenital developmental anomalies leads to deformation of the middle third of the face, disharmony of the development of the facial skeleton, grossly violates the functions of various vital organs and systems, aesthetics of the face and negatively affect the formation of the psycho-emotional status of the child. In most cases, this pathology leads to disability of children, which underlines the relevance of this medical and social problem in the world.

Impression taking and plaster model production are established methods in dentistry and plaster models serve as basis for documentation and diagnosis. In orthodontics, model analysis is used routinely and is a key factor to treatment planning and review of orthodontic progress. In recent years, digitalization techniques in dentistry have advanced and methods to digitalize plaster models into 3D virtual models have been established. In 1999, Align Technology Inc. (San Jose, California, USA) introduced OrthoCad, which is a digital model service, based on a proprietary scanning process of plaster models [10]. Orthoanalyzer software is a convenient tool for offers a workflow for a step-by-step analysis of the models of patients with cleft lip and palate, also offering software for a diagnostic set-up.

The requirements of patients with cleft lip and palate extend beyond surgical repair. A multidisciplinary approach to the care of patients with cleft lip and palate is the widely accepted standard protocol in most regions of the developed world. However, the existing shortages of healthcare resources have precluded provision of the most basic care to patients with cleft lip and palate. Innovative technology applications may facilitate the performance of the evaluation of dental arch dimensions in these patients [6].

The digital casts provide a relationship with the craniofacial plane. The study of the dental arches of cleft lip and palate patients contributes for a better understanding of the morphological alterations of the dental arches, which can be useful in the preventive and corrective treatment of cleft lip and palate patients [2, 10, 11].

Recently, the three-dimensional (3D) scanner was presented in literature as a tool for analysis of arch dimensions and landmarks on cleft lip and palate casts. It produces 3D data from the surface structures of the cast using scanning techniques. The potential benefit of this tool for landmark positioning and analysis is a matter of discussion [3, 4].

The article presents the possibilities of virtual planning of complex treatment of children with CLP using the program Ortho Analyzer visual planning. Using the methods of computer diagnostics and modeling in the conditions of the modern health care system will allow to obtain the most accurate data on the condition of of patients with cleft lip and palate. The accuracy of the data obtained during the planning of the primary surgical and/or orthodontic stage for treatment of children with CLP allows for the most accurate assessment of the position and inclination of the fragments of the alveolar processes of the upper jaw for treatment planning taking into account the individual characteristics of the anatomical structure of the jaw bones of each patient with CLP.

MATERIALS AND METHODS:

Pre-treatment plaster model sets of 20 patients were randomly selected from patients with cleft lip and palate assessed for treatment at the Moscow State Medical University (Sechenov University), department of pediatric dentistry and orthodontics. All plaster models were made in the same laboratory, with similar time intervals from impression taking to model production. The criteria for inclusion were patients with unilateral cleft lip and palate, similar shape of the models—with a base parallel to the occlusal plane—and full integrity of the model: cracked or damaged models were not used. After applying these criteria, 19 models remained in the pool of cases. The patients' ages ranged between 1 and 4 months; 9 male and 10 female.

Maxillary dental casts were obtained in all patients (20 infants) at the period prior orthodontic and surgical treatment (Figure 1). All casts were assessed by an orthodontist and a maxillofacial surgeon in the course of treatment planning. These casts were taken as a part of medical treatment protocol when necessary (Figure 2).

Each model was given a number. Every model was digitalized using a 3D laser scanning system with two cameras with 5.0 megapixels each (D800; 3Shapedental, Copenhagen, Denmark). The accuracy of this scanner is 15 microns according to the manufecturer. The collected data were saved and imported to Ortho Analyzer software for further editing. Furthermore, the virtual model were oriented in the Ortho Analyzer to the occlusal plane before measurements were performed (Figure 3).

Fig.1. Child seated on the lap of the mother to perform the impression (parents signed informed consent authorizing the publication of this picture)

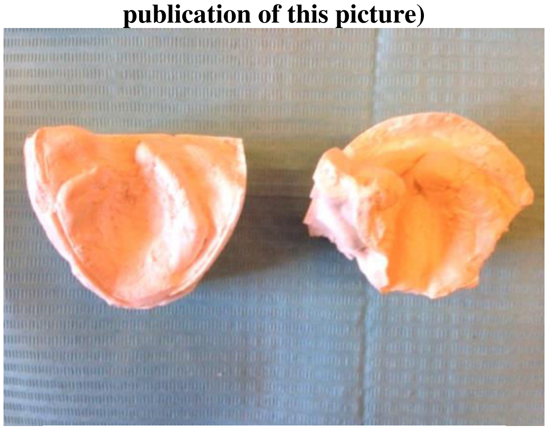

Fig.2. Study casts with standardized cuts proportional to the dental-alveolar areas

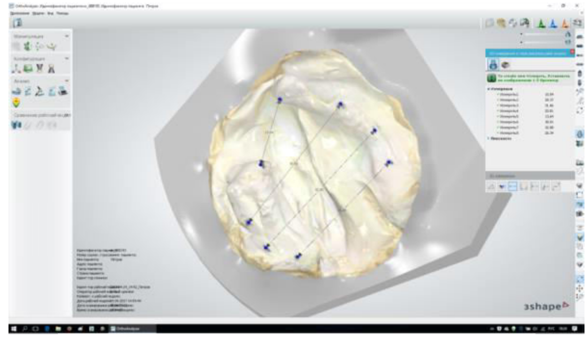

Fig.3. Screen of the computer showing the digitalized cast and the respective measurements

In process magnification or zooming in the desired model area was allowed, in order to give maximal resolution. Data was collected at the stage of patient assessment before primary cheiloplasty and after the surgical treatment. Dental cast wee evaluated and analyzed through Ortho Analyzer software.

RESULTS:

Analysis of the anthropometric study of the models showed that the position of the upper maxillary fragments has deviations from the norm in the sagittal and vertical dimensions. The result of the diagnostic data was confirmed by the computer diagnostic system Ortho Analyzer measuring the digital model.

Measurement of linear and angular parameters was carried out using computer data of digital models with Ortho Analyzer (Figure 4, 6).

Over the entire treatment period (T1-T2) (Table 1), the alveolar cleft width (G-L) gradually decreased ($p < 0.01$), the cleft palate width (X-Y) decreased ($p < 0.01$), the anterior width of the maxilla decreased in the projection area (C (R) -C (L)) ($p < 0.05$), the width of the palate in the tuber area (F (R) -F (L)) ($p < 0.05$), a decrease in the median deviation was also observed (A- A1).

In the course of treatment (T1- T2), changes in the parameters of the upper jaw anthropometric changes were observed as expected.

In all patients after primary cheiloplasty we observed canges in the movemrnt of dentoalveoral segments of the maxilla on both clefted and non-clefted sides in the vertical, sagittal and transverse directions. In the vertical plane there was a movement towards the occlusal plane. In the transversal plane, cleft narrowing occurred due to a change in the X-Y parameters. In the sagital direction underdevelopment of the upper jaw was maintained or slightly increased (3 + 0.9 mm).

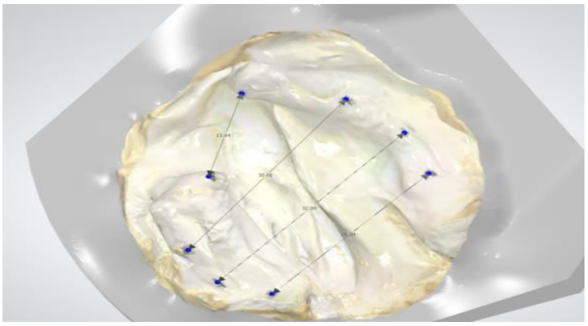

Fig.4. Digitalized cast and the respective measurements before surgical treatment (Primary cheiloplasty)

The diastasis between fragments of the alveolar process (G-L) continuously decreases during the observed period in. The average G-L distance was 10.42 mm before cheiloplasty. After primary cheiloplasty this distance decreased by 50%. This decrease in distance between clefted alveolar ridges was observed during the first three months after surgery. Then the value of diastasis (G-L) gradually continued to decrease up to the age of 12 months (Figure 5).

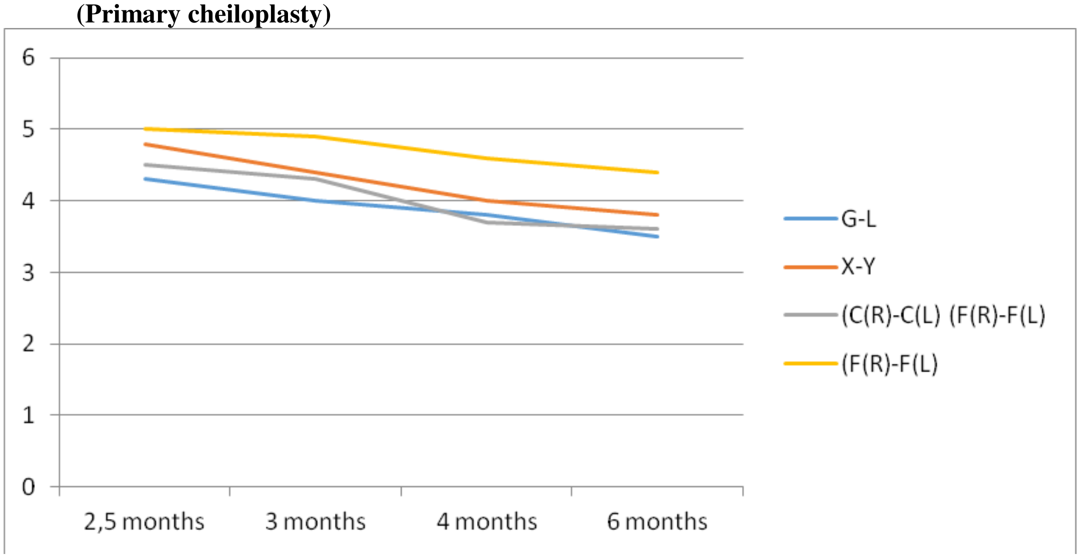

Fig.5. Changes in the parameters of the upper jaw during the treatment period before and after primary cheiloplasty.

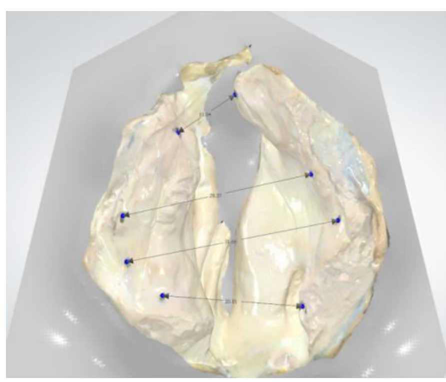

Fig.6. Digitalized cast and the respective measurements after surgical treatment (primary cheiloplasty)

Table 1. Change in anthropometric parameters in children with CLP during the treatment period.

Parameter	T1/M+m	T2/M+m	T-criteria
G-L	14,08+0,91	10,07+0.65	T1-T2-p<0,001 T2-T2-p<0,01
C(R)-C(L)	31,80+1,08	28,04+1,31	T1-T2-p<0,05
D(R)-D(L)	25,50+0,95	23,62+1,11	T1-T2-p<0,05
F(R)-F(L)	27,09+0,64	28,08+0,78	н/д
Y-X	8,95+0,87	6,07+0,81	T1-T2-p<0,01
Y-O	24,03+0,55	22,97+0,71	T1-T2<0,01
X-O	8,07+0,46	11,01+0.62	T1-T2-p<0,01
A-O	27,3+1,21	28,7+1,18	unreliable

DISCUSSION:

A multidisciplinary approach to the care of patients with cleft lip and palate is the widely accepted standard protocol worldwide. However, the shortages of healthcare resources have affected most basic care protocols for patients with cleft lip and palate. Innovative technology applications may facilitate the performance of the evaluation of dental arch dimensions in these patients which could positively improve orthodontic and surgical workflow protocol.
Ortho Anazyer program makes it possible to effectively evaluate the anatomical structures of the upper jaw fragments of patients with CLP, as well as dynamically evaluate the anthropometric parameters of the jaw fragments during treatment. The use of Ortho Anazyer software is an effective platform for collecting and analyzing data from an anthropometric study in patients with CLP. Using the program allows practitioner to effectively and accurately assess the condition of the maxillofacial system of children with CLP at all stages of treatment and is an effective tool in the complex of measures for treating and analyzing the results of it at all stages of CLP patient treatment planning, increasing its effectiveness.

CONCLUSION:

3D laser-scanned plaster model analysis has shown to be most useful and reliable alternative to the conventional method of model analysis with an analogue calliper and is more more efficient in everyday practice with children with cleft lip and palate. Ortho Analyzer software digital model analysis should is reliable and accurate tool for treatment planning for children with cleft lip and palate.

Automatized calculation and storage of acquired data is one of the most important tools of the software digital programming. It is most efficient in optimizing orthodontic and surgical planning.

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