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IMPACT OF TELEMEDICINE ON VIRTUAL PLANNING FOR ORTHOGNATHIC SURGERY

IMPACTO DA TELEMEDICINA NO PLANEJAMENTO VIRTUAL DA CIRURGIA ORTOGNÁTICA

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RESUMO

Objetivo: O objetivo desse estudo foi avaliar a influência da telemedicina no planejamento virtual de cirurgia ortognática e comparar o planejamento realizado por meio de exames complementares na ausência e na presença de exame físico presencial dos pacientes. **Materiais e Métodos:** A avaliação prospectiva realizada no Hospital Getúlio Vargas, na cidade de Recife, Brasil, estudou o impacto da telemedicina no planejamento virtual de cirurgia ortognática, comparando o planejamento realizado por dois avaliadores (ortodontista e cirurgião bucomaxilofacial) por meio de exames complementares. na ausência e presença de exame físico dos pacientes. **Resultado:** A amostra foi composta por dez pacientes com indicação de cirurgia ortognática, cujo planejamentos foram realizados por dois avaliadores diferentes. Mudanças no planejamento foram feitas após exame físico de pelo menos 50% e até 100% dos pacientes. Os movimentos que foram encontrados alteração após o exame físico foram dimensão vertical, rotação do plano oclusal, linha média, rotação e avanço do mento. **Conclusão:** O exame físico é de extrema importância para a coleta de informações dos tecidos moles e duros para auxiliar na determinação dos movimentos cirúrgicos de cada indivíduo, garantindo resultados mais seguros e satisfatórios.

Palavras-Chave: cirurgia ortognática, imagem tridimensional, telemedicina.

ABSTRACT

Objective: The present study aimed to assess the telemedicine influences on virtual planning for orthognathic surgery and compare planning made through complementary exams in the absence and presence of an in-person physical examination of patients. **Materials and methods:** A prospective cohort study was conducted at Getúlio Vargas Hospital in the city of Recife, Brazil, to assess the impact of telemedicine on virtual planning for orthognathic surgery by comparing planning performed by two evaluators (orthodontist and oral-maxillofacial surgeon) through complementary exams in the absence and presence of a physical examination of the patients. **Result:** The sample was composed of ten patients with an indication for orthognathic surgery, the planning of which was conducted by two different evaluators. Changes in planning were made after the physical examination of at least 50% and as much as 100% of the patients. The movements for which change was found after the physical examination were the vertical dimension, occlusal plane rotation, midline, chin rotation, and advancement. **Conclusion:** The physical examination is extremely important for collecting information on soft and hard tissues to assist in the determination of surgical movements for each individual, ensuring safer and more satisfactory results.

Keywords: orthognathic surgery, imaging, three-dimensional, telemedicine.

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INTRODUÇÃO

Orthognathic surgery involves esthetic and functional components for the correction of dentofacial deformities[1]. The success of surgical planning depends on the proper diagnosis considering skeletal, dental, and soft tissue aspects[2].

A well-executed clinical examination is the basis of a correct diagnosis and consists of data from the patient chart as medical history includes physical examination and complementary exams[3,4]. The physical examination of soft tissues, bones, temporomandibular joint, the proportions of the upper, middle, and lower thirds of the face, aspects of swallowing, speaking and the breathing pattern are pertinent to the assessment in orthognathic surgery[3].

The new generation of dentofacial imaging systems based on computed tomography scans and intraoral scanning offers advantages in the construction of diagnosis and surgical planning of dentofacial deformities correction by enabling a three-dimensional (3D) volumetric representation of soft and hard tissues of the head and face. Such images can be viewed on a 1:1 scale without the overlapping of anatomic structures, ensuring greater reliability of the image and surgical planning[5,6].

With the assistance of means of communication, advances in complementary exams and the rising of 3D software for surgical planning, the use of virtual medicine has become increasingly common in the orthognathic surgery field, which has enabled the online planning of surgery without direct contact between the patient and health professional in charge of surgical planning.

Since the onset of the COVID-19 pandemic, telemedicine has become a acceptable practice throughout the world in all health fields and exponential growth has occurred in the number of healthcare providers who offer online appointments. Many Brazilian Oral and Maxillofacial surgeons are currently following a trend of outsourcing the surgical planning of their patients to companies or other individuals. This often involves conducting the planning through online meetings without conducting an in-person physical examination of the patient.

Technological benefits often give rise to intriguing questions. One of these regards the possible inversion of values of conventional diagnostic methods. Is 3D software to which all data on the patient is provided capable of replacing – and with considerable advantages – an in-person physical examination by a Oral Surgeon?

To address this question, the present study aimed to assess the telemedicine impact on orthognathic surgery virtual planning and compare surgical planning made through complementary exams in the absence and presence of an in-person physical examination of patients.

MATERIAIS E MÉTODOS

This prospective cohort study was developed in the department of oral-maxillofacial surgery of Getúlio Vargas Hospital in the city of Recife, Brazil, and received approval from the Human Research Ethics Committee of University of Pernambuco (protocol number: 45593021.0.0000.5207; approval number: 4.688.917) in accordance with Resolution 466/2012 of the National Board of Health[7].

Between July 2012 and January 2023, the GETULIO VARGAS hospital admitted patients with dentofacial deformities who needed surgical jaw correction. The sample was defined by convenience. The inclusion criteria were pattern II or III dentofacial deformity, vertical maxillary excess, vertical maxillary deficiency, facial asymmetries, age between 18 and 59 years, and absence of oral and maxillofacial pathology associated with the jaw bones. The exclusion criteria were class I facial pattern, dentofacial deformities manageable with an orthodontic treatment, a history of orthognathic surgery, and temporomandibular disorders.

After signing the informed consent statement, the patients were submitted to a

standard massive preoperative protocol[12]. Virtual planning was performed with Dolphin Imaging 11.95 Premium software in the absence and presence of a patient physical examination. This study was conducted at Getúlio Vargas Hospital, Ave. Gen. San Martin, Recife, Brazil, from July 2021 to January 2023.

The participants were eligible to orthognathic surgery for the treatment of dentofacial deformities and were submitted to presurgical planning by two evaluators – an orthodontist and oral maxillofacial surgeon – on two different situations. The first planning was made using data collected from patient chart and facial analysis with the aid of the questionnaire used by Arnett and McLaughlin[12], photographs of the patient, and digital files from computed tomography of the face and intraoral scanning, which were inserted into the Dolphin Imaging 11.95 Premium software. At this time, the evaluators had no physical contact with the patients. The second planning was performed with the data from all documentation used in the previous planning plus a complete physical examination involving in-person contact between the evaluators and patients either to validate the previous planning or alter it based on the information collected during the physical examination.

A single, experienced, previously calibrated researcher was in charge of the preoperative documentation, which comprised the patient history[12], taking of photographs, facial analysis, intraoral scanning, and request for computed tomography.

Intraoral scanning was performed using the 3 Series Scanner Powered By DWOS. Facial photographs were taken with a Canon DC 7.4 v camera using the same sensor sensitivity, aperture opening and shutter speed for all patients, with the head in the neutral position oriented by the researcher in the frontal, frontal with smile, profile, inferosuperior positions with the head at rest and in centric relation. Intraoral photographs were also taken. Computed tomography was performed with the same device (16-channel Siemens SOMATOM Scope Brilliance) using a face tomography protocol with slices of 0.75 mm and 1.0 mm spacing between slices, the tragus-canthus line perpendicular to the horizontal plane and teeth in central occlusion for all patients.

A single, experienced, previously calibrated researcher was in charge of entering the preoperative documentation and the re-creation of the skull with the Dolphin Imaging 11.95 Premium program, which was subsequently used by the orthodontist and surgeon for the surgical planning.

The skull was recreated by the input of the clinical data of the patients through the overlapping of the 3D images of the intraoral scanning, computed tomography and 2D photograph superimposed on the 3D volume of the tomogram. This was necessary due to the presence of metal artifacts on the dental surfaces of the computed tomograms caused by restorations and orthodontic appliances appearing imaging debris which complicates the planning process.

From the image of the skull, surgical simulation was performed by the two evaluators beginning with the demarcation of the osteotomies desired for each case: sagittal splitt osteotomy of the mandible, Le Fort I osteotomy or segmental Le Fort I osteotomy and chin osteotomy. After the osteotomies, desired movements were performed following to the clinical study and quantification of the deformity. These movements obeyed a standard sequence under the universal protocol[8].

The data were analyzed descriptively with the calculation of absolute and relative frequencies for categorical variables. The Kappa coefficient was used to determine the level of agreement between evaluators with the aid of IBM SPSS version 20.0 for Windows (Statistical Package for the Social Sciences).

RESULTADOS

This study involved a convenience sample of ten patients submitted to virtual planning for orthognathic surgery with and without a physical examination by two evaluators – an orthodontist (evaluator 1) and an oral-maxillofacial surgeon (evaluator 2). Orthodontist made changes to the planning for five patients (50%) and Surgeon made changes to the planning for nine patients (90%), which was nearly twofold more compared to the first evaluator. This difference was statistically significant (Table 1).

Table 1: Absolute and relative frequency of the variables according to whether there was a change by each evaluator.

Variables	Changes	Orthodontist		Surgeon	
		n	%	n	%
Evaluator	Yes	5	50,00%	9	90,00%
UPPER MIDLINE	Yes	0	0,00%	3	30,00%
MAXILLARY CANT	Yes	0	0,00%	4	40,00%
VERTICAL DIMENSION	Yes	2	20,00%	5	50,00%
OCCLUSAL PLANE ROTATION	Yes	3	30,00%	4	40,00%
YAW	Yes	0	0,00%	2	20,00%
MAXILLO MANDIBULAR ADVANCEMENT	Yes	0	0,00%	6	60,00%
CHIN RETRACTION	Yes	0	0,00%	2	20,00%
CHIN MIDLINE	Yes	1	10,00%	4	40,00%
CHIN ROTATION	Yes	1	10,00%	2	20,00%
CHIN ADVANCEMENT	Yes	1	10,00%	2	20,00%
CHIN INTRUSION	Yes	0	0,00%	2	20,00%
CHIN EXTRUSION	NO	0	0,00%	0	0,00%
NATURAL HEAD POSITION	Yes	0	0,00%	10	100%
Total		**10**	**100,00 %**	**10**	**100,00 %**

The movements for which changes were found after the physical examination were the vertical dimension, occlusal plane rotation, midline, chin rotation and advancement. For Orthodontist , the movement with the greatest frequency of change was occlusal plane rotation (30%). For Surgeon, the movement with the greatest frequency of change was the vertical dimension (50%), followed by occlusal plane rotation (40%), maxillary cant (40%) and chin midline (40%).

Table 2 displays the level of agreement between the evaluators regarding the absolute differences in millimeters or degrees of the planned movements. The overall frequency of agreement was 40%. The variable with the highest level of agreement was chin extrusion (100%); no change in this movement was performed on any of the ten patients by either of the two evaluators. A high level of agreement was also found for the movements yaw (80%), retraction and intrusion of the chin (80%), and chin rotation and advancement (70%). The movements with the lowest level of agreement were the natural position of the head (0%), maxillomandibular advancement (40%), and the vertical dimension (30%).

Table 2: Level of agreement between the evaluators 1 e 2.

Variables	% CONCORDANCE
Evaluator 1 x 2	40,0%
UPPER MIDLINE	70,0%
MAXILLARY CANT	60,0%
VERTICAL DIMENSION	30,0%
OCCLUSAL PLANE ROTATION	50,0%
YAW	80,0%
MAXILLOMANDIBULAR ADVANCEMENT	40,0%
CHIN RETRACTION	80,0%
CHIN MIDLINE	50,0%
CHIN ROTATION	70,0%
CHIN EXTRUSION	100,0%
CHIN ADVANCEMENT	70,0%
CHIN INTRUSION	80,0%
NATURAL HEAD POSITION	0%

DISCUSSÃO

Telemedicine emerged at the end of the 1960s, but the industry only began to show continual growth and refinement in terms of implementation and practice beginning in the 1990s. The reasons for this were mainly the development, rapid expansion, ease of access, and lower cost of the internet and digital communication technologies. The industry was also propelled by the ease of access to healthcare services on the part of the population and the lower cost for patients as well as businesses and self-employed healthcare providers[9].

Thousands of healthcare services and hospitals currently outsourcing this kind of service and there are multiple ways to apply telemedicine – whether by a single healthcare provider conducting care from beginning to end or by a coordinated team[9].

In the field of orthognathic surgery, the practice of telemedicine has had significant impacts. The facility of means of communication, advances in complementary exams, and the emergence of virtual surgical planning software, the practice of online surgical planning has become increasingly common, with no direct contact between the patient and professional in charge of planning.

The importance of the present study

resides in the assessment of the impact of telemedicine on virtual planning for orthognathic surgery. Despite the numerous advantages of 3D virtual planning, this modality is based on a static representation of tissues through imaging exams. However, dynamic information on tissues, which is only acquired through a detailed physical examination, is also considered important to the final planning of surgery[10].

In the present study, both evaluators altered the surgical planning of at least 50% of the patients after the in-person physical examination. In agreement with data described in previous studies[10], the present investigation demonstrated that the in-person physical examination is a determinant in virtual surgical planning capable of leading to changes in the planned movements and consequently altering the results of surgery.

The movements changed by both evaluators were the vertical dimension, occlusal plane rotation, midline, chin rotation and advancement (Table 1). Despite the agreement in the changes of these movements between the two evaluators, there are no reports in the literature that explain the fact that particular movements require more changes than others.

Evaluator 2, who was an oral-maxillofacial surgeon, altered the orientation of the head in the software for 100% of the patients when compared to the natural head position of the patients determined during the in-person physical examination. However, neither evaluator performed a change in the orientation of the head on any of the patients (Table 2). By definition, the natural head position is the most balanced position assumed when an individual in a relaxed posture gazes toward an infinite horizon or an object at eye level. The planning and execution of surgery in a virtual environment is only possible after this step. Despite the high degree of detailing, the digital file of the virtual skull often does not present a correct spatial orientation and calibration is required to orient its position exactly as patients present themselves clinically[11].

Considering its importance to virtual planning, once altered, the natural head position can change the entire surgical planning. Thus, as Surgeon changed the head position in the virtual model for all patients, changes occurred in the movements of all patients (100%) in the sample (Table 2). This is likely because the natural head position influences the anteroposterior position of the glabellum, pogonion and lip relationship with regards to the true vertical line. The orthodontic examiner planning was also altered after the physical examination of 50% of the patients, despite no change in the natural head position. Thus, although the natural head position is a determinant in planning, the lack of change in this position does not preclude the possibility of changes to the planning after the physical examination of the patient.

The frequency of changes to surgical planning after the physical examination on the part of the two evaluators. Evaluator 1 (orthodontist) made changes to the planning in 50% of the sample, whereas Evaluator 2 (oral and maxillofacial surgeon) made changes in 100%. The divergent results between the evaluators are explained by the different standpoints of the two specialties. Oral and Maxillofacial surgeons have expertise in the planning and execution of orthognathic surgery and, therefore, a keener vision for the facial aspects analyzed during the physical examination in comparison to orthodontists.

The present study constitutes a warning for patients, surgeons and orthodontists who are migrating to digital platform for orthognathic surgery that the presential examination is extremely recommended for the obtainment the safe, satisfactory esthetic and functional outcomes. Future studies should have a larger sample of patients to ensure a more complete comparison from the statistical standpoint as well as validate the present findings and, if possible, find explanations for the imprecisions observed in this study.

Based on the results of the present investigation, the physical examination exerts a strong impact on orthognathic surgery virtual planning, as the planning of surgery by the surgeon and orthodontist was altered in more than half of the sample after the in-person assessment. Thus, it is extremely important for the practitioners who determine surgical planning to first perform an in-person assessment of the patient through a thorough

physical examination to collect information on the natural head position as well as soft and hard tissues to assist in the determination of surgical movements necessary for each individual and provide surgery with safer, satisfactory improving the results.

CONCLUSÃO:

The physical examination exerts a strong impact on orthognathic surgery virtual planning, as the planning of surgery by the surgeon and orthodontist was altered in more than half of the sample after the in-person assessment. Thus, it is extremely important for the practitioners who determine surgical planning to first perform an in-person assessment of the patient through a thorough physical examination to collect information on the natural head position as well as soft and hard tissues to assist in the determination of surgical movements necessary for each individual and provide surgery with safer, satisfactory improving the results.

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