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Research Article

OUR EXPERIENCE IN SURGICAL TREATMENT OF PATIENTS WITH INJURIES OF THE ORBITAL FLOOR WITH COMBINED INJURIES OF THE FACIAL SKELETON

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ABSTRACT

Under our supervision there were 117 patients with fractures of the inferior wall of the orbit on the basis of the department of plastic surgery and the department of neurosurgery of the multidisciplinary clinic of the Tashkent Medical Academy in the period from 2019 to 2022. Surgical treatment of zygomatic-orbital complex injuries and isolated injuries of the lower wall of the orbit was performed according to the technique developed by us, observing a number of features depending on the severity and localization of injuries, as well as the timing of the surgical intervention using modern information technologies. A method for eliminating post-traumatic defects in the walls of the orbit, including performing computer preoperative planning, manufacturing an implant, determines the indications and contraindications for surgery, low-traumatic access to the damaged area, in addition, it also helps to reduce postoperative complications by 2.4 times, resulting in a reduction in the period of functional adaptation of patients in 1.6 times.

KEYWORDS

Orbit, zygomatic-orbital complex, trauma, computed tomography, implant, porous titanium plate, 3D modeling, 3D construction.

INTRODUCTION

Up to date, the problem of traumatic injuries of the middle zone of the face remains extremely relevant. According to the scientific literature, the number of traumatic injuries is still increasing and in 2015 almost 5 million people were fatally injured [10, 11, 21]. One of the directions for developing measures to improve medical care for patients with urgent pathology was the study of injury rates [12, 28]. It is noteworthy that until the 1970s, purulent-inflammatory diseases of the face and neck were the prevailing pathology, then there was a gradual increase in the number of patients with traumatic injuries. In the structure of traumatic injuries, fractures of the lower jaw and fractures of the upper jaw are leading throughout the years [5, 13, 27].

There has been a trend towards an increase in the number of patients with injuries of the middle zone of the facial skull, in particular, fractures of the wall of the maxillary process of the orbit, which is associated with a continuing increase in domestic, transport and industrial injuries [25, 26]. Trauma of the orbit involving the organ of vision and its auxiliary organs among all injuries of the facial skeleton ranges from 36 to 64%. According to a number of authors, the main cause of blindness and low vision in people of childhood and working age are injuries to the eye and orbital structures, which approximately account for 20% of all pathologies of the organ of vision [6, 9, 22].

Among all traumatic injuries of the maxillofacial zone, 40% are orbital fractures, of which in more than half of the cases the lower wall from the medial part, the infraorbital sulcus, is damaged. Combined damage to several anatomical structures, trauma to the eyeball, polymorphism of clinical manifestations, and the need to develop optimal tactics for surgical treatment require the use of a complex of radiation diagnostic methods [15, 24].

Thus, the increase in the total number of injuries, combined damage to the bone and soft tissue anatomical structures of the midface, trauma to the eyeball and its musculoskeletal system dictates the need for timely diagnosis of such conditions for preoperative planning and postoperative control.

With a wide range of modern options for the reconstruction of the midface, plastic materials and surgical approaches, today there is no unified protocol for the management of patients with injuries of the midface, questions on the choice of indications for surgery, the timing of surgical intervention and the technique of performing the operation remain debatable [2 , 4, 13, 16, 29]. The criteria for successful surgical treatment are the correct timing of the operation, surgical access, and tactics of the operation with the correct choice of various materials for reconstruction [8, 18]. As implants and grafts of the

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walls of the orbit, the following are used: autologous bone from the anterior wall of the maxillary sinus, rib, parietal bone, branches of the lower jaw, titanium implants without coating and coated with high-density polyethylene, polytetrafluoroethylene, silicone [17, 19, 20].

In accordance with many years of research by foreign scientists, alloys based on titanium nickelide are among the most prominent representatives of the class of alloys that produce the shape memory effect. It has been established that superplastic medical materials based on titanium nickelide outperform all existing metallic materials in terms of biochemical and biomechanical compatibility criteria [3, 7].

One of the perfect methods for diagnosing and planning surgical treatment is 3D technology, virtual computer simulation. 3D planning allows you to plan and determine the scope of the operation, the selection of the implant, determining the size and type of the implant, as well as its fixation [1, 5, 14, 23]. That is why the possibility of effective surgical treatment using 3D reconstruction is relevant. In this regard, the aim of our study was to improve the planning and surgical treatment of patients with fractures of the orbital walls in concomitant trauma.

MATERIAL AND METHODS

The study is based on examination data of 117 patients with injuries of the zygomatic-orbital complex who were treated in the department of plastic surgery and neurosurgery of the multidisciplinary clinic of the Tashkent Medical Academy in the period from 2019 to 2022. The prevailing majority of patients were aged 21 to 40 years. Data analysis shows that the clinical study was dominated by young (88 patients, 75.2%) and middle (29 patients, 24.8%) individuals, which indicates the social significance of the study. Among all patients (n=117; 100%), there was a predominance of males (n=100; 85.5%) over females (n=17; 14.5%). Most patients were injured as a result of traffic accidents (n=71; 60.7%).

All patients admitted for examination were distributed depending on the time of injury, according to the 3 main stages of the process of formation of post-traumatic deformities. In the acute period (up to 4 weeks), 102 patients (87.2%) were admitted, during the period of emerging post-traumatic deformities - up to 3 months after the injury - 7 patients (6.0%) were hospitalized, in the stage of formed post-traumatic deformities, 8 patients applied for examination patients (6.8%).

All patients (n=117; 100%) admitted for examination underwent a collection of complaints and anamnesis, a clinical examination by a maxillofacial surgeon, a neuropathologist and an ophthalmologist - the criteria for ophthalmological assessment consisted of: assessment of facial configuration, orbits and skin condition ; assessment of the movement of the eyeballs; assessment of visual function. Examination using methods of radiation diagnostics - MSCT with 3D reconstruction was performed on a GE Light Speed 64 device. Tomography of the facial skeleton was performed with the following parameters: slice thickness - 0.6 mm, slice collimation - 64 * 0.6, mA / slice - 200, voltage - 120 kV, increment - 0.6, pitch - 0.5, reconstruction resolution - high, radiation exposure - 0.4 - 0.8 mSv. The patient's head was previously freed from all removable metal elements and laid flat on the headrest. The patient's gaze was asked to be fixed centrally. Laser marks were used to accurately determine the scanning area. To mark the study area, a topogram was performed. Tomography was started from the top of the skull to the lower border of the body of the lower jaw (or from the frontal region to the alveolar process of the upper jaw). MSCT data in the axial, sagittal, and coronal planes were supplemented with a multispiral reconstruction in the coronal and sagittal planes with the construction of a 3D reconstruction.

An anthropometric analysis of a post-traumatic defect in the wall of the orbit and maxillary sinus was also performed. For the study, multislice computed tomograms were used in axial, sagittal and coronal sections. Anatomical structures were measured using the RadiAnt licensed software package for viewing CT scans in DICOM format. Orbital wall defects were measured in axial, sagittal, and coronal sections. The maxillary sinus was measured in height - the largest vertical dimension on the sagittal section and width - the largest width on the sagittal section.

And in addition to the direct examination of the patient, studies were used on the obtained digital photographs taken on a Canon EOS 90 D camera equipped with a Canon 18-105 mm f73.5-5.6G lens. Photographs of the full-face projection and the state raised back were studied. All patients underwent photometric analysis before and after surgery. The first series of photographs for the patient after the operation was taken on the 2nd day, then the second series of photographs was taken 10 days later. Long-term results of photographing were carried out after 3-6 months. Photos before and after surgical treatment served as a control over the result.

RESULTS AND DISCUSSION

All patients in the preoperative period were made a computer 3D model of the orbit with a stereolithographic intraoperative template printed on a 3D printer. – first of all, after the MSCT examination, files in the DICOM format are transferred to a special program Implant-Assistant (version 4.2.1) based on the tomographic examination data, a virtual three-dimensional model of the bones of the face and the area of the post-traumatic defect of the orbital wall is created with a reconstruction interval of 0.6 mm s multispiral reconstruction of the obtained images in sagittal and coronal projections. The received data is converted into stl format. and are transferred to the 3D laboratory to the specialists of process engineers for virtual modeling, for the manufacture of a surgical template of the implant. Based on the data obtained, a specialist process engineer sequentially synthesizes, first, the volumetric parameters of the preserved orbital wall, and then the volumetric parameters of the orbital wall with an anatomical defect. Next, symmetrical (mirror) computer transformations are performed, and by combining (overlapping) these parameters, the differential estimate determines the volumetric mathematical parameters of the implant, the contact surfaces of which are adapted to specific anatomical objects of the skull of a particular individual.

A complete set of information about the volumetric mathematical parameters of an individualized implant is exported in an automatic prototyping device - a Formlabs form 2 3D printer, and a surgical implant template is made. Then, using a surgical template, we make an individual implant from a porous titanium plate, and then send it for sterilization.

The computer planning of the surgical intervention made it possible to: clarify the location and nature of the damage, assess the condition of the oculomotor muscles, the position of the eyeball, detect prolapse of the orbital tissue and clarify the size of the defect in the walls of the orbit, which is especially important for choosing an orbital implant and planning surgical intervention.

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All patients underwent surgery under general intubation anesthesia and included the stage of osteosynthesis of the lower edge of the orbit and endoprosthesis of the orbital walls.

The terms of surgical treatment of patients were as follows: on days 5-14 - 102 (87.2%) patients and after 1-2 months. after injury - 15 (12.8%).

Surgical treatment of injuries of the zygomatic-orbital complex and isolated injuries of the inferior wall of the orbit was performed according to the technique developed by us, observing a number of features depending on the severity and localization of injuries, as well as the timing of the surgical intervention. The most important stage of the operation was the careful revision of orbital fractures, the release of the restrained oculomotor muscles, the elimination of prolapse of the orbital fat, and the most important is the plasty of the bone defect of the lower wall of the orbit, based on a stereolithographic intraoperative template, which determines the exact size, shape of the implant and its location. fixation, and the implant itself is a porous titanium plate. In the postoperative period, all patients were prescribed standard anti-inflammatory therapy, and rehabilitation was carried out together with an ophthalmologist to restore eye function.

On the 8th day after the operation, the following was carried out: removal of postoperative sutures, clinical examination of the periorbital region, photographing of the patient was carried out in a double project. Then a second clinical examination with photographs was carried out one month after the operation. 3 months after the operation, the patient undergoes a second examination: clinical examination, photography, MSCT examination, general blood test, consultation with an ophthalmologist and, if necessary, a neuropathologist. After 6 months and a year later (repeated examination is carried out: clinical examination, photography, MSCT examination, general blood test, ophthalmologist's consultation). The duration of surgery was 49.8±2.6 minutes. The duration of stay in hospital treatment in patients was 3.6 ± 0.2 days. The patient spent 10.2 ± 0.2 days on outpatient treatment. The total period of disability in these patients was 13.8±0.2 days. 14 days after the operation, diplopia was reduced in 8 (6%) patients.

On the 8th day after the operation, the following was performed: removal of postoperative sutures, clinical examination of the periorbital region, the patient was photographed in two projections.

Then a second clinical examination with photography was carried out one month after the operation.

3 months after the operation, the patient undergoes a second examination: clinical examination, photography, MSCT examination, complete blood count, consultation with an ophthalmologist and, if necessary, a neuropathologist.

After 6 months and a year later (re-examination is underway: clinical examination, photographing, MSCT examination, complete blood count, consultation with an ophthalmologist).

The duration of the surgical intervention was 49.8±2.6 minutes. The length of stay in hospital for patients was 3.6±0.2 days. Patients were on outpatient treatment for 10.2±0.2 days. The total period of disability in these patients was 13.8±0.2 days. 14 days after the operation, diplopia persisted in 8 (6%) patients.

CONCLUSION

Thus, the planning of reconstructive surgery using computer modeling allows the use of stereolithographic intraoperative templates on a 3D

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printer. This technique helps to reduce the time of surgical intervention and increases the accuracy of planning and implementation of surgical treatment. 3D planning allows you to plan and determine the scope of the operation, the selection of the implant, determining the size and type of the implant, as well as its fixation.

The proposed method for eliminating post-traumatic defects in the walls of the orbit, including performing computed tomography of the facial part of the skull, measuring parameters, synthesizing volumetric parameters based on the data obtained, manufacturing an implant, determines the indications and contraindications for surgery, low-traumatic access to the damaged area, and also helps to reduce postoperative complications in 2.4 times, such as impaired sensitivity in the region of innervation of the infraorbital nerve (by 12.9%), facial asymmetry (by 11%), diplopia (by 16.7%), enophthalmos (by 13.3%), etc.

When evaluating the effectiveness of the proposed method of surgical treatment of fractures of the walls of the orbit and the zygomatic-orbital complex, good results with stable positive dynamics were established in 90.6% of cases.

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