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Transnasal Surgical Treatment Of Patients With A Fracture Of The Medial Wall Of The Orbit

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ABSTRACT

The article presents the method of transnasal surgical treatment of patients with a fracture of the medial wall of the orbit using the Volkov elevator as a repositioning tool and an iodine tampon as a fixation material, which allows efficient fixation of the medial orbit wall fragments and its soft tissue components, allowing to reduce the trauma of surgical intervention, to restore the eyeball position, and to eliminate the cause of emphysema and dynamic correction of postoperative diplopia in one-time operation.

KEYWORDS

Orbital Wall Fractures, Zygolorbital Complex Injuries, Transnasal Techniques, Iodoform Tampon, Volkov Elevator.

INTRODUCTION

Isolated orbital fractures occur in 16.1% of fractures involving the orbit. Diagnosis and treatment of such injuries in the acute period is difficult, and the occurrence of permanent post-traumatic deformities is often the reason for multistage reconstructive treatment. The main clinical signs of fractures in the medial wall of the orbit are diplopia and restriction of

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eyeball movement. Diplopia is more often associated with a significant displacement of bone fragments and soft tissue components of the orbit into the paranasal sinuses. Restriction of eyeball movements is observed in 86% of medial orbital wall fractures and in 12% of inferior orbital wall fractures. The advent of high-resolution CT scans with a slice thickness of less than 1 mm allows for an accurate diagnosis in these patients at an early stage and planning of surgical treatment (Fig. 1). The choice of the best and least traumatic surgical access and, most importantly, the method of reconstruction, remains an issue. Para-orbital accesses, although allowing adequate inspection of the injured area, are associated with the risk of damage to large nerve and vascular trunks, which limits reconstructive surgery to the medial wall of the orbit. Одной из причин низких эстетических результатов при них является рубцовое укорочение нижнего века с появлением «зияющей склеры» (scleral show). An alternative to the classic approach for injuries to the medial wall of the orbit is the transnasal approach, which is widely used by oral surgeons. It is widely used in oral and maxillofacial surgery. G. Killian was operating on the sphenoidal sinus, removing part of the labyrinth cells and exposing a "paper plate". F.S. Bockstein's surgical techniques in the area of the labyrinth in ethmoiditis are described in detail. The beginning of endoscopic rhinosurgery was laid down by the works of W. Messerklinger in the 70s, and the widespread introduction of this method started after the publication of D.W. Kennedy and H. Stammberger in the mid-80s. The first reports on transnasal endoscopic endoscopic repositioning of the medial orbital wall for orbital fractures dated 2000. The authors also describe the difficulties of instrument positioning and fixation of fragments in the tissue altered by trauma in their article, which undoubtedly highlights the relevance of our study.

Research objective: Transnasal surgical treatment of patients with a fracture of the medial wall of the orbit

MATERIAL AND METHODS

We followed up 22 patients with a unilateral fracture of the medial wall of the orbit with an injury duration of 2 to 14 days. Among all patients there were 15 males (68%) and 7 females (32%) aged from 19 to 60 years. The average age was 35 years (34 years for men, 32,5 years for women). 5 patients (22%) were diagnosed with the isolated fracture of the medial wall of the orbit with displacement of the bone fragments and paroorbital tissue into the area of the labyrinth, 10 patients (45%) had the combined damage of the medial and inferior walls of the orbit. A large splinter fracture of the zygomatic bone with damage to the lower and medial walls of the orbit and a fracture of the nasal bones were diagnosed in 7 (33%) patients. Radiological signs of posttraumatic ethmoiditis were observed in 19 (86%) patients. All patients complained of paresthesias of varying severity in the innervation areas of the second branch of the trigeminal nerve on the injured side. The patients were divided into two groups according to the nature of surgical interventions: the main group consisted of 15 patients (68%) who underwent surgical interventions with the use of an iodoform tampon for fixation of fractures; the comparison group consisted of 7 patients (32%) operated on without the use of an iodoform tampon. In our surgical treatment, we had two main objectives. The first was to perform gentle repositioning of the medial orbital wall.

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The second was to create an adequate temporary immobilization. The Volkov elevator was used as a tool for transnasal reposition of the medial orbital wall. All operations were performed under general anaesthesia. Rigid fixation of the head was an obligatory condition for the surgical intervention. Rigid fixation excludes the possibility of the patient's head intraoperative displacement and provides stable coordination of the surgeon's actions. As a traditional method of treatment of patients with orbital trauma in the acute period, a combined access to the orbital wall was used: along the upper eyelid, subciliary (in order to release the impinged paro-orbital tissue) and intraoral (through which a reposition of the orbital bone structures with their fusion with titanium miniplates was performed). We performed sanation of the maxillary sinus with revision of the natural anus and if necessary, application of an anus into the lower nasal passage, and a balloon catheter was used as a temporary support for the lower orbital wall. Transnasal access to the damaged structures in the main group, transnasal repositioning of the medial wall of the orbit and fixation of fragments using a yoform tampon were performed.

Table 1. Distribution of patients by group

Characteristics of groups	Main group	Comparison group
Fracture of the medial wall of the orbit	3 (13%) (10%)	2
Fracture of the medial and lower orbital wall	8 (36%)	2 (10%)
Combined injury zygomatico-orbital complex	4 (18%) (13%)	3

The technique of transnasal repositioning of the medial wall of the orbit should be discussed in more detail. Polyposal changes of the mucosa in the anterior nasal cavity and middle nasal passage are the first obstacle to identifying the anatomical landmarks necessary to initiate surgery. Hasty removal of polyposis tissue causes bleeding of the mucosa, which significantly interferes with the beginning and course of the entire operation, therefore, we used the Volkov elevator for repositioning, which is less traumatic and does not require removing the polyposis-altered tissue, and the bleeding of the mucosa stops after inserting the iodoform tampon. The use of the Volkov elevator avoids trauma to these masses and penetration into the area of the anterior cranial fossa, and the preoperative multispiral computed tomography examination of patients with medial orbital wall fractures greatly simplifies orientation in areas of low visualisation. Bone fragments in the lamina papyracea area can be easily instrumentally repositioned using the Volkov elevator. The degree of repositioning of the medial orbital wall was determined based on the individual anatomical features of the structure of the orbit on the intact side, with computer planning capabilities allowing the projection of the bone structures of the intact orbit onto the surgical intervention area, a "mirror reflection" effect. We used iodoform

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tampons for fixation of the bone fragments, which were removed 7-10 days after the operation. We did not observe any clinically significant complications during all surgeries. Only in one case we observed instability of the iodoform tampon on the 3rd day after surgery, which required its removal. In the nearest postoperative period (1-3 days after the operative treatment) the clinical signs of the local reaction activity of the tissues on the operative intervention according to the degree of the eyes chemosis and edema intensity in the scores (the modified Draize test) were estimated.

Table 2. Distribution of patients by degree of chemosis

Degree of chemosis (scores)	Main group (n = 15)	Reference group (n = 7)
0	1(7%)	0(-)
1	9 (60%)	1 (14 %)
2	5 (33%)	5 (72%)
3	0 (-)	1 (14%)

Table 3. Distribution of patients according to the severity of eyelid edema

Degree of eyelid swelling (scores)	Main group (n = 15)	Reference group (n = 7)
0	3 (20%)	0 (-)
1	9 (60%)	1 (14%)
2	3 (20%)	4 (58%)
3	0 (-)	2 (28%)

The distribution of patients according to the degree of chemosis in the nearest postoperative period shows the prevalence of more expressed degree of local tissue reaction to the operative intervention in the comparison group: degree 2 and 3 in patients with trauma of the orbital complex were registered in 10 (77%), while in the main group patients - in 5 (33%). The eyelid edema degree also shows the predominance of the local reaction of tissues to the surgical intervention in patients with injuries of the medial orbital wall in the control group: degree 2 and 3 were registered in 6 (86%) patients, while 3 (20%) in the main group patients. In the nearest postoperative period, 2 (9%, n = 22) patients were diagnosed with a constant diplopia when looking straight ahead; we did not observe a constant diplopia when looking upwards in the long-term follow-up (6 months to 2 years) but 4 (57%, n = 7) patients in the comparison group showed a diplopia when "looking up". Restriction of the eyeball mobility in the immediate postoperative period was found in 5 (71%, n = 7) patients in the comparison group and in 1 patient (7%, n = 15) in the main group. In the long-term period (6 months to 2 years), we observed a symptom complex including restricted mobility "when looking up" and diplopia "when looking up" in 5 (71%, n = 7) patients in the comparison group, while the patients in the main group did not have any

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such complaints. The main cause of the symptom complex, in our opinion, was rough scarring of the paro-orbital tissue and atrophy of the eye muscles, which was confirmed by computed tomography data. Our observations showed that the incidence of various complications in the treatment of orbital trauma by traditional methods was 90.6% among all patients. Suborbital neuritis, visual impairment manifested as diplopia, and impaired eyeball mobility predominated among them. Post-traumatic sinusitis was less common.

Clinical example Patient L., 28 years old, was admitted for: "Closed head injury, concussion of the brain, fracture of the lower and medial wall of the left orbit". From the anamnesis it is known that the injury was sustained in a sporting event. Ophthalmological status: hemophthalmos on the left, hypophthalmos on the left - 6 mm, enophthalmos on the left - 4 mm, constant diplopia when looking straight ahead, visual acuity OD = OS = 1.0, no evidence of damage to the eyeball, limited mobility of the left eyeball when looking up and to the left. Chemosis stage 2, eyelid edema stage 1. A series of computed tomograms revealed a fracture of the lower and medial walls of the left orbit with displacement of bone fragments. The patient was consulted by a neurologist and prescribed symptomatic therapy for closed head injury and concussion. Preoperative laboratory examination was performed, there was no evidence of abnormal values. For the purpose of preoperative planning, the patient's DICOM computed tomography data were uploaded to the BrainLAB iPlan planning station. Created a patient folder including: patient name, identification number, date of creation. A horizontal Frankfort plane was planned. A 32 cm long Volkov elevator with a working diameter of 12 cm was recorded to accurately determine the position of the working instrument during the surgical intervention. Using the Volkov elevator through the middle nasal passage a repositioning of the medial wall of the left orbit was performed. In order to fix the repositioned bone fragments of the medial orbital wall, the cavity was tamponaded with an iodoform tampon after opening the lattice cells. In addition, an intraoral incision was made along the transitional fold on the left, the deformed anterior wall of the maxillary sinus was exposed, and a trepanation window up to 1.0 cm in diameter was created. Revision of the left maxillary sinus revealed a traumatically altered lower orbital wall. A reposition of the lower stalk of the left orbit was performed, and the suborbital canal was revisited. The sinus cavity was sanitised. In order to create a temporary support of the lower orbital cavity wall, an iodine-form swab was inserted into the cavity of the sinus, its end goes into the lower nasal passage. The wounds were sutured with separate knotty sutures. Hemostasis was performed in the course of the operation. On the 10th day, the iodoform tampon was removed from the nasal passages, and on the 14th day, the iodoform tampon was removed from the left maxillary sinus. Ophthalmological status on the 14th day after the operation: left hemophthalmus, no hypophthalmus or enophthalmus, no diplopia, no limitation of eyeball mobility, visual acuity OD = OS = 1.0, one degree of chemosis, oedema - 0 degree. The patient was discharged to out-patient treatment in satisfactory condition. The control tomography survey 6 months after the operation showed no signs of the left orbital bone structures deformation. The presumed aesthetic and functional outcome of the treatment was achieved.

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CONCLUSIONS

The suggested technique of surgical treatment of patients with trauma of the medial orbital wall with application of transnasal technique and iodine-form tampon introduction for fixation of bone fragments allowed developing a technology of elimination of posttraumatic neuropathy of trigeminal nerve branches and enophthalmos and reducing the rehabilitation period for patients, which is of significant social and economic importance. Transnasal techniques in combination with fixation of bone fragments with iodine-formed tampons make it possible to achieve complete functional recovery.

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