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LONG-TERM EFFECTS OF INFERIOR ORBITAL WALL FRACTURES ON THE DENTOALVEOLAR SYSTEM IN CHILDREN

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Resume: Fractures of the inferior wall of the eye socket in children are one of the most common injuries in pediatric maxillofacial surgery. These injuries can have a long-term impact on the development of the dentoalveolar system. Untimely or inadequate treatment of such injuries can lead to disruption of normal jaw growth, facial asymmetry, and the development of various bite disorders, which subsequently require additional orthodontic intervention and surgical corrections. Studying these consequences is important for improving the quality of diagnosis and the choice of treatment methods, as well as for developing preventive recommendations.

Key words: Isolated fractures of the inferior wall of the orbit in children, trauma to the facial skeleton, anatomo-physiologic features of the pediatric orbit, maxillary sinus, computed tomography.

Резюме: Переломы нижней стенки глазницы у детей - одна из самых распространенных травм в детской челюстно-лицевой хирургии. Эти травмы могут оказывать долгосрочное влияние на развитие зубочелюстной системы. Несвоевременное или неадекватное лечение таких травм может привести к нарушению нормального роста челюстей, асимметрии лица, развитию различных нарушений прикуса, которые впоследствии требуют дополнительного ортодонтического вмешательства и хирургической коррекции. Изучение этих последствий важно для улучшения качества диагностики и выбора методов лечения, а также для разработки профилактических рекомендаций.

Ключевые слова: Изолированные переломы нижней стенки орбиты у детей, травма лицевого скелета, анатомо-физиологические особенности детской орбиты, верхнечелюстной пазухи, компьютерная томография.

INTRODUCTION: Most studies have focused on orbital fractures in adult patients, whereas only a few publications with small numbers of patients have been devoted to assessing the diagnosis and course of blast fractures of the orbit in children.

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Blast fractures of the orbit include fractures without damage to the orbital ring (edge). Orbital fractures in children are distinguished by a different mechanism of bone wall damage, which includes so-called 'trapdoor' ('backdoor') fractures. Due to the elasticity of the orbital bones, hatch type fractures are more common in children, which creates conditions for prolapse of orbital tissues, their impingement on the side of the fracture and for the occurrence of oculocardial syndrome (Aschner reflex). [1].

Orbital injuries account for 36 to 64% of all blunt trauma to facial bones. In 85% of identified cases of orbital bone fractures, patients are hospitalised [2-5]. In many countries the number of orbital injuries according to GBD (The Global Burden of Disease Study) is increasing [5]. According to Russian data, there was an increase in orbital injuries as a result of road traffic accidents from 4.9% in 2007 to 12.8% in 2010, and in the general statistics in recent years domestic injuries prevail, reaching 64.5% of cases [6, 7]. The more frequent causes of orbital trauma in children are: direct impact (44-61%), road traffic accidents (15.8%), falls from a height (15%) in polytrauma, and sports injuries (9-11%) [8-10].

Fracture of the inferior wall of the orbit is one of the most common injuries in the structure of maxillofacial fractures in children. It occurs at any age, more often in adolescents. As a rule, damage to the eye cavity occurs as a result of domestic, sports, street or unlawful trauma (blow with a fist or blunt object, fall from a height, road traffic accident, etc.).

Isolated fractures of the inferior wall of the orbit in children occupy a significant place among the injuries of the facial skeleton, making up to 10-20% of all cases of orbital injuries in paediatric patients. This problem is especially relevant due to the anatomo-physiological features of the children's orbit: thinness of bone structures, presence of growing tissues and high plasticity of the organism. In children, the lower wall of the orbit is most susceptible to traumatic effects due to its thinness and close proximity to the maxillary sinus [11].

It is practically impossible to determine the presence and localisation of blast fractures of the inferior wall of the orbit using routine radiographic methods [6]. Computed tomography (CT) is the main method of diagnosing these types of fractures.

Often, due to the small displacement of orbital bone fragments, radiological diagnosis of fractures is difficult and uninformative. Multispiral CT with reconstruction in sagittal and coronal projections and three-dimensional (3D) reconstruction provides optimal and comprehensive visual information about the damage to the bony structures of the orbit. Soft tissue imaging as well as magnetic resonance imaging (MRI) are used to evaluate the intraorbital contents. To date, there are no clear indications for the use of each technique and there is no complete picture of the CT characteristics of orbital injury [8, 11, 18]. A number of specialised CT techniques of the facial skeleton are superior to other imaging modalities in characterising facial bone damage [8, 12-14]. However, studies in the USA and South Korea have shown that contrast-free (native) head CT helps to reliably assess most orbital injuries in children, which in many cases reduces the need to use thin-section CT of the orbits, which increases radiation exposure in this category of patients [15-17]. Unfortunately, there are

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no recommendations for imaging of orbits in axial projection to detect and evaluate facial fractures in children.

Fracture of the inferior orbital wall may be observed as a component of a massive fracture of the zygomaticomandibular complex (which usually causes crushing of the thin orbital wall) or as an isolated fracture (the less commonly observed 'blast' orbital fracture) caused by a very sudden increase in intraorbital pressure. 'Explosive' fracture usually results from an impact with an object directed at the eyeball (e.g., a fist or ball) that is slightly larger than the orbit and penetrates the ocular space only a short distance. The sudden increase in pressure results in fracture of the ocular bones at the weakest points, usually in the region of its inferior or medial wall [12,19].

The aim of our study is to evaluate the long-term effects of inferior oculomandibular wall fractures in children on the dentoalveolar system, and to identify how untimely or inadequate treatment may contribute to the development of bite abnormalities, asymmetry and jaw deformity.

Materials and Methods. Thirty children (7-14 years old) with isolated fracture of the lower wall of the eye socket treated at the Tashkent State Dental Institute were included in the study. The patients were observed for 1.5 years after treatment. Anamnesis was studied in all patients, comprehensive ophthalmological examination was performed: Visometry with optimal correction, refractometry, biomicroscopy, ophthalmoscopy, determination of the character of vision using the four-point colour test according to Wors, tonometry, perimetry, cephalometry (analysis of SNA, SNB, ANB angles, lower face height), radiography and MSCT to assess anatomical changes, as well as orthodontic diagnosis using models of dental rows and functional tests to study bite changes. The position of the eyeball was also determined using Hertel's mirror exophthalmometer, sensitivity along the innervation of the inferior oculomotor nerve and oculocardiac syndrome (OCS) were assessed.

Radiological data were obtained (computed tomography, axial thickness at least 1 mm), and after digital segmentation and mirroring of the healthy orbit to the fracture site (iPlan CMF 3.0.5, Brainlab, Munich, Germany), a patient-specific implant was designed. The decision to reconstruct the medial wall was made strictly in the coronal projection. The boundary was marked using markings. In addition, the posterior bulge was analysed in the axial projection and virtually reconstructed. After data transfer to KLS-Martin (Tuttlingen, Germany) or Synthes (Umkirch, Germany), fabrication was performed by selective laser melting using Ti6Al4V Grade IV titanium alloy. The thickness of the PSI was 0.3 mm with a 0.5 mm thick cord around the circumference. The entire workflow from data acquisition to delivery of the ready-to-use product took between 6 and 8 working days.

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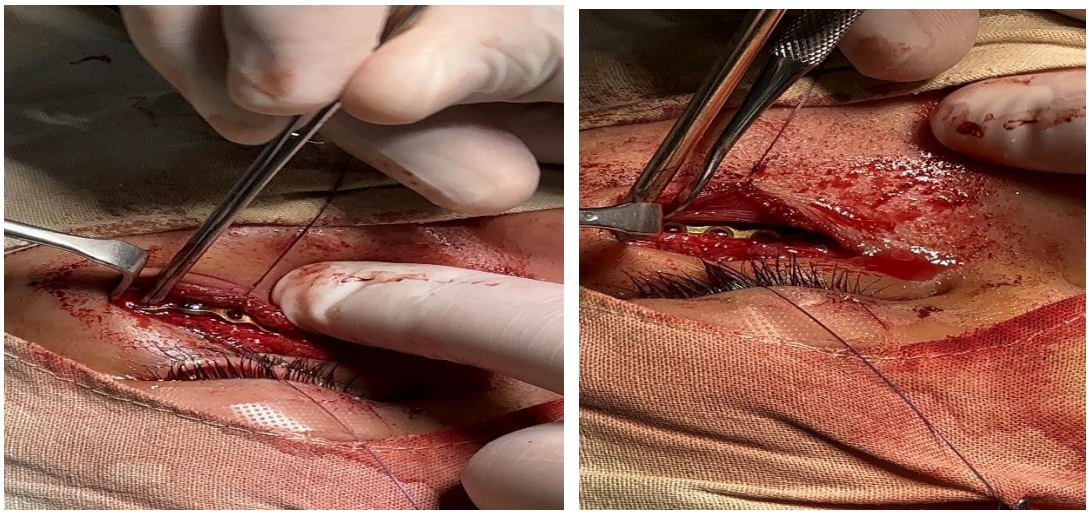

Figure 1. Operation procedure for computer-assisted, navigated PSI implantation for orbital reconstruction.

Data were collected and stored using Excel spreadsheets (Excel 13.0, Microsoft Corporation). Statistical evaluations were performed using SPSS® programme (SPSS version 25.0, IBM SPSS). Multivariate analysis of variance with repeated measures per factor was performed to record statistical relationships between groups and time. The relationship between orbital parameters and therapy regimen was performed using binary logistic regression, chi-square tests, t-tests, and McNemar's test. Results with p-value less than 0.05 were considered significan.

Results and Discussion. The results of the study showed that fractures of the inferior oculomandibular wall in children can cause long-term changes in the dentoalveolar system, such as bite disorders (crossbite), facial asymmetry and mandibular deformities. Thirty per cent of children had bite changes after trauma and 25 per cent had marked facial asymmetry due to improper repositioning of the inferior ocular wall. Untimely treatment increases the risk of complications such as bone sclerosis, which hinders normal jaw growth. It is important to provide timely and adequate treatment using modern diagnostic techniques to minimise long-term consequences and prevent the need for further orthodontic and surgical interventions.

Conclusion. Fractures of the inferior wall of the oculomandibular wall in children can have a lasting impact on the development of the dentoalveolar system. Untimely or inadequate treatment of such injuries can lead to bite changes, facial asymmetry and jaw deformities. Regular follow-up of patients with such injuries, as well as timely intervention using modern diagnostic and treatment methods, can minimise long-term consequences and prevent the need for complex orthodontic and surgical interventions in the future.

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