

Digital Technologies in the Surgical Treatment of Post-Traumatic Zygomatico-Orbital Deformities

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The aim of the study was to determine the efficacy of using digital technologies in patients with post-traumatic deformities of the zygomatico-orbital complex (ZOC) by comparing the results with the conventional methods of surgical treatment.

Materials and Methods. The article summarizes treatment results of 231 patients with ZOC injuries who underwent surgery at the clinical facilities of Privolzhsky Research Medical University (Nizhny Novgorod) in 2011–2019. There were treated 44.2% (102/231) of patients with post-traumatic deformities of ZOC, including 38.2% (39/102) with post-traumatic defects and deformities of the orbital floor.

Based on clinical and radiological planning of surgical operations, the patients were divided into two groups: group 1 included patients who underwent surgery without preoperative virtual planning (54.9% (56/102) of cases), group 2 included patients who underwent virtually planned surgical interventions (45.1% (46/102) of cases). There were 22 and 17 patients with orbital deformities in groups 1 and 2, respectively.

Results. The optimal restoration of ZOC anatomy was observed in 75% (42/56) of patients in group 1 and 93.5% (43/46) of patients in group 2. During reconstruction of the orbital floor in patients of group 1, successful results were achieved in 68.2% (15/22) of cases and 88.2% (15/17) in group 2, various complications were observed in the rest of cases.

Based on the analysis of surgical treatment results, there was developed a personalized approach to manufacturing of zygomatic bone and orbital floor implants using computer modeling and 3D printing technologies.

Conclusion. In contrast to the conventional methods, the use of digital technologies in the surgical treatment of post-traumatic deformities of ZOC allows avoiding the problematic issues of implant positioning and the development of complications during reconstruction, significantly reducing surgical injury and improving patient rehabilitation.

Key words: orbital deformity; zygomatico-orbital complex; post-traumatic deformity; enophthalmos; orbital reconstruction; facial implants; digital technologies in the treatment of facial injuries; three-dimensional modeling of implants.

Introduction

One of the main tasks of the surgeon performing operations in the middle face is to increase treatment efficacy and improve the quality of life in patients after injury. In injury of the zygomatico-orbital complex (ZOC), especially, that with pronounced dislocation of fragments, delayed or unplanned surgery or its absence can lead to aggravation of injuries to the orbit, eyeball, oculomotor muscles, orbital fat, and the optic nerve. As a result, patients develop persistent post-traumatic deformities of the zygomatic area and the orbit, functional and aesthetic disorders requiring long-term multi-stage treatment [1–3]. According to various data [2–4], fractures of the zygomatic bone account for 20 to

37.5% of all injuries to the bones of the facial skeleton and 35–40% of these are orbital floor fractures.

Orbital fractures disrupt the anatomy and physiology of the orbit, which leads

to ophthalmic and neurological disorders (deformity and change in the volume of the orbit, diplopia, restriction of eye movement, lost or impaired vision, hypoesthesia of the infra-orbital nerve) developing in the early post-traumatic period. Later, in the absence of treatment, hypo- and enophthalmos are likely to develop, diplopia, and cosmetic disorders progress [4–6]. These changes make it possible to consider ZOC injuries the most complicated in terms of reconstruction and restoration of impaired functions.

To date, the optimal algorithm for the management

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Fritz A. Moeller, 1975 *Fundamentals of Foot Surgery* E. Dalton McGlamry, Rebekah McGlamry, 1987 **Journal of the American Podiatry Association** American Podiatry Association, 1977 *The Surgical Management of Deformities in Leprosy and Other Peripheral Neuropathies* Noshir H. Antia, Carl Damien Enna, Behman M. Daver, 1992 The commonest peripheral nerve disease in man is leprosy It is estimated that over 12 million people suffer from this disease and about a fourth of them have some deformity However the majority of deformities seen in leprosy are not peculiar to the disease They are also seen in other peripheral neuropathies including trauma and systemic diseases like diabetes The principles of management and surgical treatment of deformities secondary to peripheral nerve disease are very much the same no matter what the cause This comprehensive volume on the subject will therefore be of value to surgeons all over the world not just in countries with a high incidence of leprosy Three major chapters of the book deal with correction of the deformities of the face the hand and the foot Three other chapters cover related aspects such as pathogenesis and pathology the skin and peripheral nerves complications and secondary disorders complementary changes and rehabilitation Illustrations are provided wherever relevant and useful The authors combined experience dates back to the fifties and they have thus been able to overview the development of reconstructive surgery in leprosy from its very inception The result is a fund of information and practical knowledge which will be useful to all surgeons working with patients with peripheral nerve disease

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