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Endoprosthesis Replacement of Maxillary Sinus Wallswith Zirconium Dioxide Implants

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Abstract

Object of the Study: *The object of the study is the patients with acquired defects of the maxillary sinus walls, the elimination of which was carried out by zirconium dioxide implants.*

Aim: *The aim is the prospect of application of the developed zirconium dioxide implant in patients with acquired defects of maxillary sinus walls in surgical practice on the basis of the analysis of postoperative complications.*

Methodology: *The study is based on the analysis of orthopaedic rehabilitation means and their effectiveness in patients of the maxillofacial surgery department of the City Clinical Hospital of Novokuznetsk for 2023-2024.*

Conclusion: *The use of standard and custom-made zirconium dioxide implants is a successful guarantee of restoration of destroyed anatomical structure.*

Keywords: Maxillary Sinus Wall Defects, Zirconium Dioxide Implants, Bioimplant, Endoprosthesis

Introduction

The aesthetic component of cranio-maxillofacial surgery, the complexity of anatomy and sensitivity of the involved systems cause difficulties and a considerable number of complications arising during endoprosthetics with different types of implants. Therefore, the relevance of a personalised approach to the creation of new bioimplants, considering the size and architectonics of the defects of the maxillary sinus walls. The existing complications arising during the surgical protocol and postoperative period require research and development to improve the effectiveness of treatment of this pathology. Taking into account the disadvantages of titanium alloys and the growing needs of patients in safe and reliable surgical protocols with the use of implants, the development of new biocompatible materials, new technologies for obtaining surfaces with a given micro-roughness and application of bio-coatings on the surface of zirconium dioxide implants and improvement of clinical protocols have made it possible to use such implants as a reliable alternative to other analogues, including those made of titanium alloys. Numerous studies show that the clinical use of zirconium dioxide implants is virtually free of biological incompatibilities in the postoperative period. The integration of ceramic implants into bone and soft tissue has been tested and confirmed. The reduction of postoperative oedema and pain syndrome should be separately noted.

The use of implants made of zirconium dioxide as a plastic material intended for the elimination of paranasal sinus wall defects was undertaken in 27 patients of the maxillofacial surgery department of the City Clinical Hospital of Novokuznetsk.

The preoperative treatment protocol was as follows. In the preoperative period, a CT scan of the facial skeleton was performed to determine the size and location of the bone defect. In case of planned hospitalization of patients, individual implants were made according to the size and architectonics of the defect. In emergency cases, the endoprostheses were selected intraoperatively from the available set of zirconium dioxide implants. The set includes two 15 mm diameter implants with 1 mm thickness, two 15 mm diameter implants with 2 mm thickness, two 20 mm diameter implants with 1 mm thickness, two 15 mm diameter implants with 2 mm thickness, two 25 mm diameter implants with 1 mm thickness, two 15 mm diameter implants with 2 mm thickness, two 30 mm diameter implants with 1 mm thickness, two 30 mm diameter implants with 2 mm thickness. The standard implants have 3 to 7 holes of 1 mm in diameter for fixation to the bone.

During surgical intervention aimed at repairing defects of the anterior wall of the maxillary sinus (6 patients), a mucosal incision is made 5 mm above the mucosal-gingival line in segments 12-16 or 22-26, and the upper-external wall of the maxillary sinus is skeletonised. In case of defects up to 10 mm in diameter, the implant is fixed with fibrin glue along the edges of the bone defect. At defects exceeding 10 mm, the implant was fixed with surgical threads (polysorb, biosyn, vicryl 4.0) to the bone bases of the defect edges, in which the holes were formed with the help of a 2 mm Lindemann cutter.

Plasty of the bone defect of the upper wall of the maxillary sinus in 14 people was performed through subcrescentic (9 cases) or trans-conjunctival access (5 cases), performing skeletonisation of the upper wall of the sinus, implants were adapted along the edges of the defect and fixed with threads or glue.

Analysing the results of surgical treatment of this group of patients, the following results were obtained. In one case, partial migration of the implant into the lumen of the maxillary sinus was observed during prosthetics of the upper wall of the maxillary sinus, which was caused by insufficient overlapping of the bone defect edges by the endoprosthesis and partial lysis of the bone base. Clinical examples of zirconium dioxide implants are presented in Figures 1, 2, 3, 4.

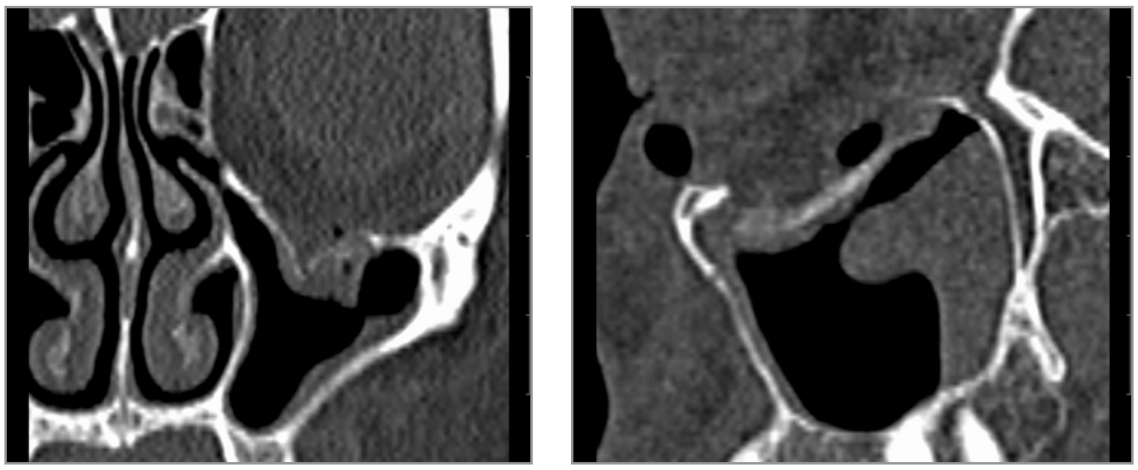

Figure 1: Fracture of the superior wall of the maxillary sinus (X-ray diagnosis - SCT)

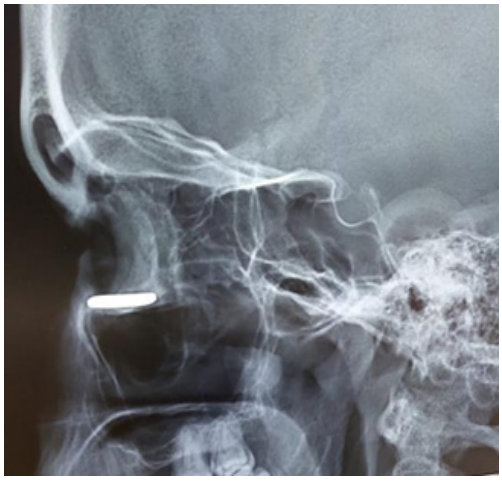

Figure 2: Repair of a bone defect in the upper wall of the maxillary sinus with a zirconia implant

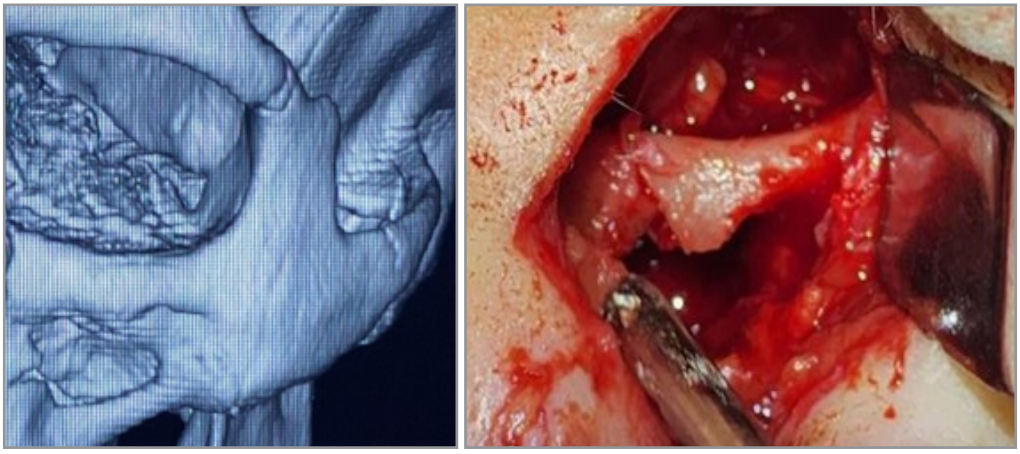

Figure 3: Fracture of the anterior wall of the maxillary sinus (CBCT and surgical observation)

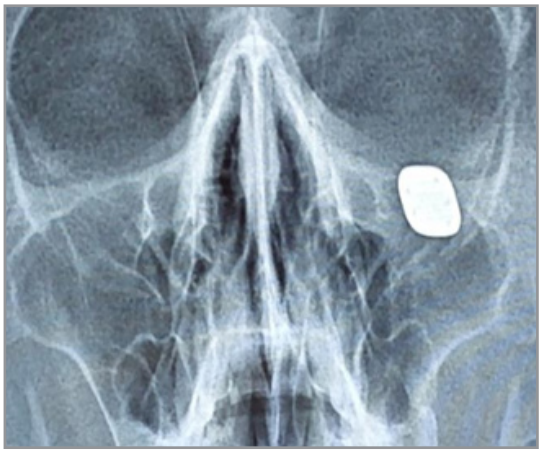

Figure 4: Repair of the anterior wall defect of the maxillary sinus with a zirconia implant - fixation with fibrin glue.

The postoperative results of surgical treatment aimed at repairing maxillary sinus wall defects using different endrepotions are shown in Tables 1-5.

Table 1: Number of complications in patients after reconstruction of maxillary sinus walls with resorbable and non-resorbable prostheses.

(n – 30)	Resorbable and non-resorbable materials	
	Near postoperative period	Distant postoperative period
Implant migration	1 (3,3 %)	2 (6,6 %)
Development of maxillary sinusitis	-	1 (3,3 %)
Limitation of eyeball mobility	-	-
Total:	1 (3,3 %)	3 (10 %)

Table 2: Number of complications in patients after reconstruction of maxillary sinus walls with autobone grafts

(n – 69)	Autobone grafts	
	Near postoperative period	Distant postoperative period
Migration of the implant	-	2 (3,4 %)
Development of maxillary sinusitis	2 (3,4 %)	2 (3,4 %)
Limitation of eyeball mobility	1 (1,7 %)	1 (1,7 %)
Total:	3 (5,08 %)	5 (8,5 %)

Table 3: Number of complications in patients after reconstruction of maxillary sinus walls with titanium alloy implants

(n – 103)	Implants made of titanium alloys	
	Near postoperative period	Distant postoperative period
Implant migration	1 (0,5 %)	1 (0,5 %)
Galvanosis	7 (3,3 %)	5 (2,4 %)
Development of maxillary sinusitis	3 (1,4 %)	3 (1,4 %)
Limitation of eyeball mobility	1 (0,5 %)	1 (0,5 %)
Total:	12 (5,7 %)	10 (4,7)

Table 4: Number of complications in patients after reconstruction of maxillary sinus walls with zirconium dioxide implants

(n – 27)	Implants made of zirconium dioxide	
	Near postoperative period	Distant postoperative period
Implant migration	1 (2,9 %)	1 (2,9 %)
Galvanosis	-	-
Development of maxillary sinusitis	-	-
Limitation of eyeball mobility	-	-
Total:	1 (2,9 %)	1 (2,9 %)

A significant number of complications were detected in the reconstruction of maxillary sinus walls with implants made of resorbable and non-resorbable materials in the distant postoperative period. In particular, implant migration was observed in 6.6 %. In addition to the above mentioned, significant complications were observed among the patients in whom titanium alloy implants were used for wall reconstruction. In the immediate and distant postoperative period, galvanosis occurred in 5.7 % of patients.

In the group of patients in whom the fixation of the perinasal sinus walls was performed with balloons (Falley catheter) the following results were obtained, namely, the analysis of complications in the immediate and distant postoperative periods is given (Table 5).

Table 5: Complications encountered during fixation of perinasal sinus walls with balloons

(n –150)	Balloon fixation techniques	
	Near postoperative period	Distant postoperative period
Development of maxillary sinusitis	1(0, 75 %)	3 (2 %)
Enophthalmos	20 (15 %)	5 (3 %)
Binocular diplopia	10 (7,5%)	6 (4 %)
Ballon rupture	6 (4%)	-
Total:	37 (25%)	14 (9,3%)

Table No. 6 shows the analysis of complications in the group of patients in whom surgical treatment was not performed.

Table 6: Complications in the group of patients receiving conservative treatment

(n – 130)	Conservative management	
	Near postoperative period	Distant postoperative period
Development of maxillary sinusitis	4 (3 %)	17 (13%)
Limitation of eyeball mobility	2 (1,5%)	11 (8,4 %)
Enophthalmos and diplopia develop	5 (3,4 %)	23 (15,64 %)
Total:	11 (7,5 %)	51 (34,7 %)

Conclusion

The use of standard and custom-made zirconium dioxide implants allows to fully restore the bony structures of the ocular walls and defects of the walls of the maxillary sinuses, to reduce the number of complications to 2.9%.

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