Plastic surgery of defects in the bones of the cranial vault with a carbon implant

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Abstract: The analysis of the results of surgical treatment of 67 patients with defects of the bones of the cranial vault previously operated for traumatic brain injury. Indications for surgical treatment are indicated depending on the size of the bone defect. Carbon composite material was used as a bone-plastic material. In most cases, a good result was obtained - 86.5%.

Keywords: skull fracture, bone defect, primary, delayed craniolastics, reconstructive surgical operations.

Relevance. Surgical interventions for the removal of brain tumors, traumatic brain injury are characterized by the formation of postoperative defects of the bones of the cranial vault. Despite the continuous creation of new techniques and materials for the reconstruction of cranial arch defects, the problem of cranioplasty is still relevant. To date, there is no consensus and algorithm for choosing materials and deadlines for cranioplasty.

There are a number of requirements for modern materials:

1. Biological compatibility;

2. No carcinogenic properties;

3. Plasticity;

4. The possibility of sterilization and combination with adaptive technologies;

5. Compatibility with neuroimaging methods;

6. Resistance to physical and mechanical loads;

7. Low level of thermal and electrical conductivity;

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8. Optimal cost;

9. Low risk of infectious and inflammatory complications.

The purpose of the study. The aim of this study is to improve the results of surgical interventions using carbon implants for cranioplasty.

Material and methods of research.

This work is based on the analysis of the results of surgical treatment of 67 patients with traumatic brain injuries treated in the neurosurgical department of the Andijan branch of the RNCEMP from 2013 to 2019. By gender distribution: men – 53 (79.1%), women - 14 (20.9%). The age of patients is from 25 to 55 years. According to the mechanism of the injury received: road – 34 (50.7%), beatings – 21 (31.3%), household – 9 (13.4%) and industrial – 3 (4.5%) patients. Decompressive bone resection trepanation of the skull was performed for all patients due to the injury. According to the location of the skull arch bone defect: frontal – 5 (7.4%), temporal – 21 (31.3%), parietal – 39 (58.2%) and occipital – 2 (2.9%) patients. The reasons for the repeated treatment of patients were: persistent headaches, epileptic-like seizures, fear of repeated traumatization of the brain, the presence of a cosmetic defect.

All patients underwent a comprehensive clinical and instrumental examination, craniography, and multispiral computed tomography (MSCT) was performed in 62 (92.5%) patients. According to the size of the skull bone defects are divided into: small (up to 10 cm2) — in 25 (37.3%) patients, medium (10 to 30 cm2) — in 36 (53.7%), large (30 to 60 cm2) — in 6 (8.9%). Reconstructive surgical interventions for skull bone defects were carried out within a period of 24 days to 3 years from the moment of injury. Primary cranioplasty was performed in 3 (4.4%) patients, 48 (71.6%) were operated on within 6 months after the injury, 13 (19.4%) from 6 to 12 months, and 3 (4.5%) patients were operated on later than 12 months after the injury.

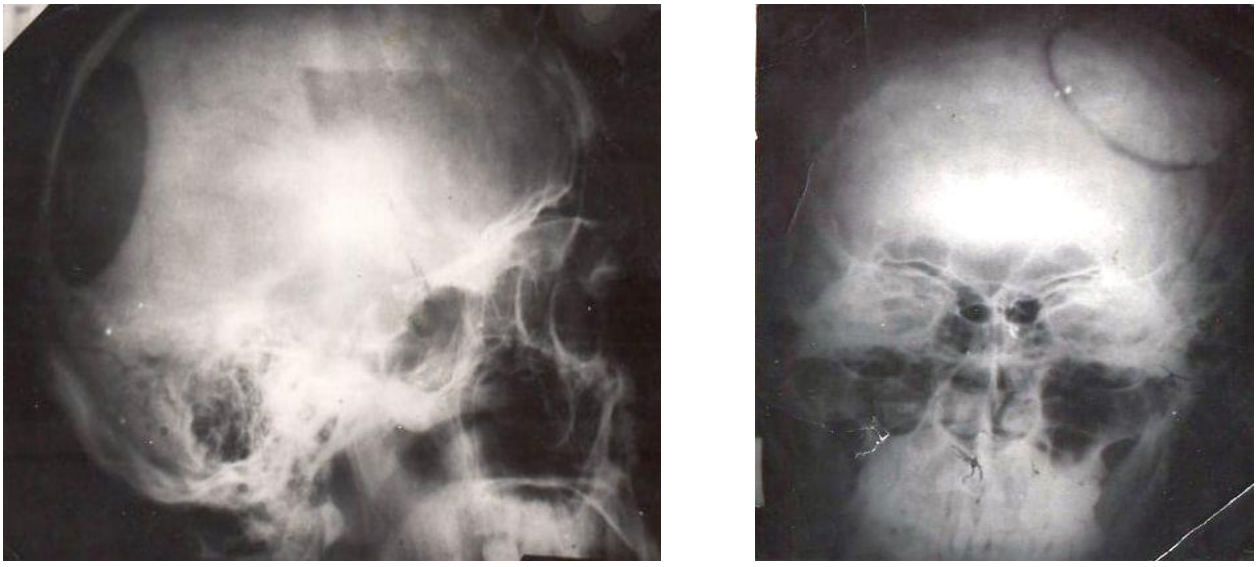

Fig.1 X-ray of a patient with a defect in the bones of the cranial vault (before and after surgery for defect repair).

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Primary cranioplasty was performed under the condition that there were no signs of significant damage to the brain substance and pronounced cerebral edema. The rest of the patients underwent repeated surgical interventions to eliminate defects in the bones of the cranial vault within the specified time frame.

In order to eliminate defects in the bones of the cranial vault, carbon implants of 2 types were used:

1 non-contrast carbon composite implants;

2 contrast carbon composite implants.

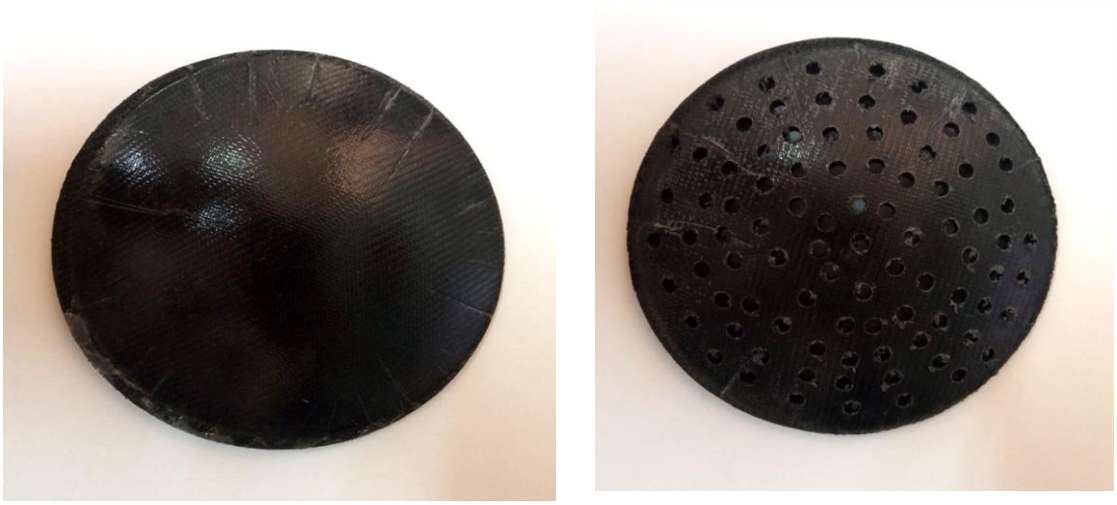

Fig.2 Types of carbon implants used.

All surgical interventions were performed under general anesthesia. Surgical technique for performing cranioplasty in all patients is standard. Initially, external meningeolysis was performed with subsequent implantation of the plate: the carbon implant was installed in the defect joint to joint and fixed with bone sutures; The sutures were removed 8-10 days after the operation.

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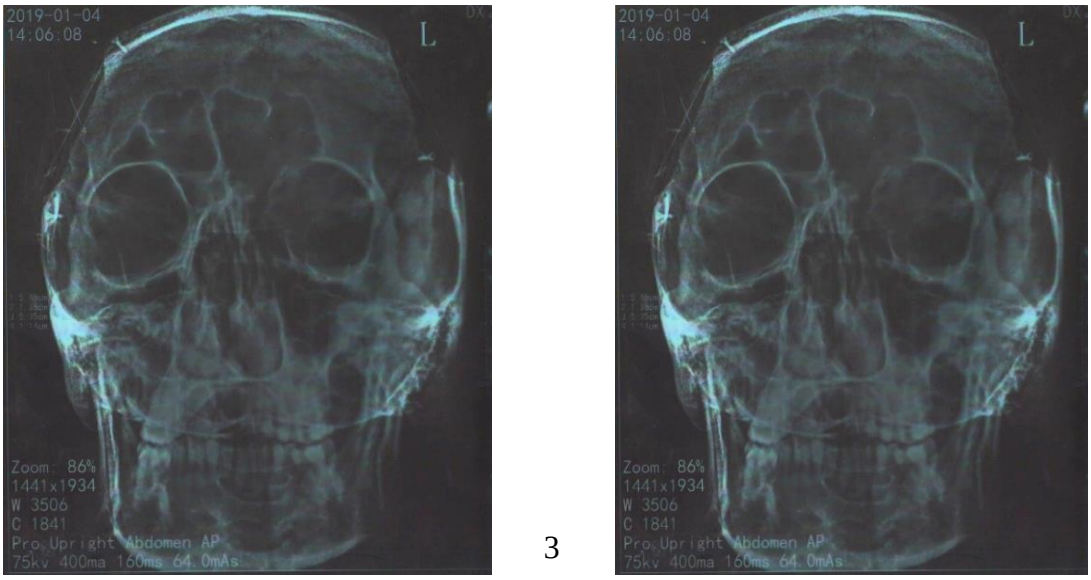
Fig. 3 

Radiograph of the patient after surgery (fastening with titanium screws)

Results and their discussion.

When analyzing the effectiveness and advantages of using implants, attention was paid to the possibility of intraoperative modeling of the implant shape. The biological compatibility of carbon materials is high, which has been proven in clinical and experimental studies. The clinical efficacy of cranioplasty was evaluated by analyzing the quality of life of patients using a unified, generally accepted for patients in the intermediate and long-term period of TBI, the Glasgow outcome scale. Taking into account the single pathogenetic mechanism of the effect of the closure of the skull bone defect on the patient's condition, the clinical response to surgery was evaluated in all patients. Consequently, the restoration of the tightness of the skull and the elimination of the cosmetic defect.

Consequently, the restoration of the tightness of the skull and the elimination of the cosmetic defect caused the elimination of the “trepanned” skull syndrome. The cosmetic result of 58 (86.5%) patients was subjectively assessed as good, 9 (13.4%) — satisfactory, due to pronounced scarring of soft tissues. Reactive seroma occurred in 6 (20.6%) patients 3-7 days after surgery, single or double percutaneous aspiration was performed. The tissue reaction was caused by a significant area of the wound surface and the need to mobilize extensive muscle-fascial flaps, manipulations in the area of basal venous collectors of the integumentary tissues of the head. After surgery, complications were observed in 4 (5.9%) patients, including hemorrhagic — in 1 (1.4%), infectious and inflammatory - in 3 (4.4%). Superficial wound infection was eliminated in 2 (2.9%) cases with the help of antibacterial therapy.

Conclusions 1. Analysis of the results of neurosurgical treatment of 67 patients for post-traumatic defects of the skull bones indicates the possibility of using carbon composite materials for cranioplasty.

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2. The use of implants is not indicated for patients in the presence of infectious and inflammatory complications with lesions of the soft tissues of the head, skull bones, central nervous system in the anamnesis, regardless of their prescription.

3. The inclusion of antibacterial agents in the structure of carbon materials will allow the use of these implants at a high risk of inflammatory complications. The introduction of carbon composite material will create conditions for the use of this material in emergency and elective neurosurgery.

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