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PLASTICS OF DEFECTS OF 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 on for traumatic brain injury was carried out. Indications for surgical treatment are indicated depending on the size of the bone defect. A 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 craniolastic, reconstructive surgery.

1.RELEVANCE.

Surgical interventions for the removal of brain tumors, traumatic brain injury are characterized by the formation of postoperative defects in the bones of the cranial vault. Despite the continuous development of new techniques and materials for the reconstruction of cranial vault defects, the problem of cranioplasty is still relevant. Until now, there is no consensus and algorithm for the choice of materials and timing of cranioplasty.

A number of requirements are imposed on modern materials:

1. Biological compatibility;
2. Absence of carcinogenic properties;
3. Plasticity;
4. Possibility of sterilization and combination with adaptive technologies;
5. Compatibility with neuroimaging methods;
6. Resistance to physical and mechanical stress;
7. Low level of heat and electrical conductivity;
8. Optimal cost;
9. Low risk of infectious and inflammatory complications.

2.PURPOSE OF THE STUDY.

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

3.MATERIAL AND RESEARCH METHODS.

The present work is based on the analysis of the results of surgical treatment of 67 patients with craniocerebral injuries treated in the neurosurgical department of the Andijan branch of the RSCEMP from 2013 to 2019. Distribution by sex: men - 53 (79.1%), women - 14 (20.9%). The patients' age is from 25 to 55 years. According to the mechanism of the injury received: road - 34 (50.7%), beatings - 21 (31.3%), domestic - 9 (13.4%) and industrial - 3 (4.5%) patients. All patients underwent decompressive osteo-resection craniotomy for the received trauma. According to the location of the defect in the bones of the cranial vault: frontal - 5 (7.4%), temporal - 21 (31.3%), parietal - 39 (58.2%) and occipital - 2 (2.9%) patients. The reasons for repeated treatment of patients were: persistent headaches, epileptic seizures, fear of re-traumatization of the brain, the presence of a cosmetic defect.

All patients underwent a comprehensive clinical and instrumental examination, craniography, and 62 (92.5%) patients underwent multispiral computed tomography (MSCT). In terms of size, the defects of the skull bones are divided into: small (up to 10 cm2) - in 25 (37.3%) patients, medium (from 10 to 30 cm2) - in 36 (53.7%), large (from 30 to 60 cm2) - in 6 (8.9%). Reconstructive surgical interventions for defects in the bones of the skull were performed within 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 from the moment of injury, from 6 to 12 months - 13 (19.4%), later than 12 months - 3 (4.5%) patients.

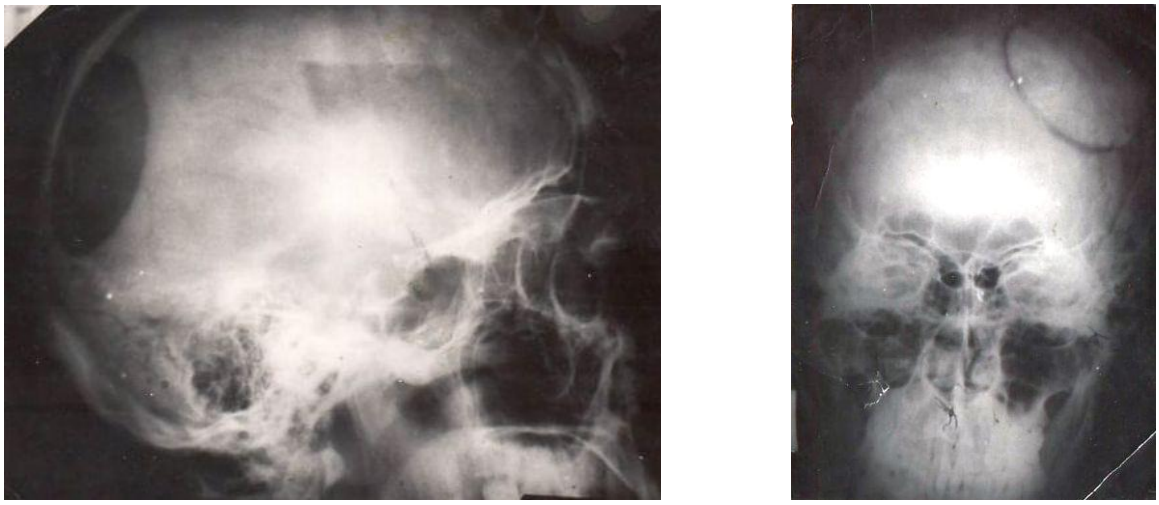

Fig. 1 X-ray of a patient with a defect in the bones of the cranial vault (before and after surgery for plasty of the defect).

Primary cranioplasty was performed in the absence of signs of significant damage to the brain substance and severe 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 contrasting carbon composite implants.

Fig. 2 Types of used carbon implants. All surgical interventions were performed under general anesthesia.

The surgical technique for performing cranioplasty in all patients is standard. Initially, external meningeolysis was performed, followed by implantation of the plate: a carbon-carbon implant was placed in the defect butt-to-joint and fixed with bone sutures; The sutures were removed 8–10 days after the operation.

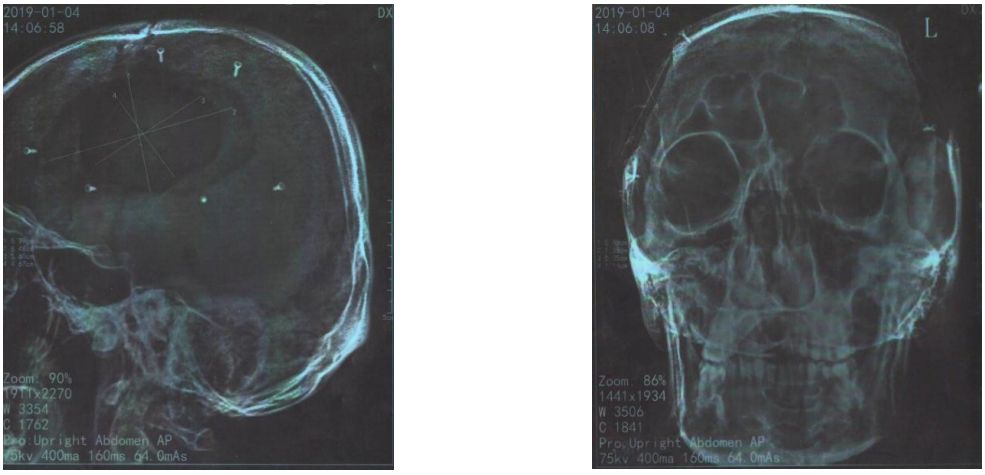

Fig. 3 X-ray of the patient after surgery (fastening with titanium screws)

4.RESULTS AND ITS DISCUSSION.

When analyzing the effectiveness and advantages of using implants, attention was drawn to the possibility of intraoperative modeling of the shape of the implant. The biological compatibility of carbon materials is high, which has been proven in clinical and experimental studies. The clinical efficacy of cranioplasty was assessed by analyzing the quality of life of patients using a standardized Glasgow outcome scale generally accepted for patients in the intermediate and long-term period of TBI. Taking into account the common pathogenetic mechanism of the effect of closure of the skull bone defect on the patient's condition, the clinical response to surgery was assessed in all patients. Therefore, 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 led to the elimination of the "trepanned" skull syndrome. All patients underwent electroencephalography using a multichannel computerized electroencephalograph DX-NT-32, before and after surgery. In all observations, a decrease in diffuse disorganization of the rhythm with a smoothing of the asymmetry of the cerebral hemispheres was noted. In 47 (70.1%) cases, in the absence of dynamics, both before and after the operation, slow-wave activity was recorded in the areas of the brain subject to the implant, which was due to neuronal depletion (cystic-glial transformation) in the outcome of contusion injury. Focal epic activity in the form of spike waves, hypersynchronous rhythms in 39 (58.2%) patients was controlled with drugs and was detected only during provocative tests. The cosmetic result was subjectively assessed by 58 (86.5%) patients as good, 9 (13.4%) - satisfactory, which is due to severe scar deformity of soft tissues. Reactive seroma occurred in 6 (20.6%) patients 3–7 days after surgery; one or two 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, to perform manipulations in the area of the 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 using antibiotic therapy.

5.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.

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

3. Integration of antibacterial agents into the structure of carbon materials will make it possible to use these implants at a high risk of inflammatory complications. The introduction of a carbon composite material will create conditions for the use of this material in emergency and planned neurosurgery.

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