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PLASTICS OF DEFECTS OF THE BONES OF THE CRANIAL VAULT WITH A CARBON IMPLANT

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ABSTRACT:

The study is based on the analysis of the results of surgical treatment of 67 patients aged 25 to 55 years, with the consequences of traumatic brain injury. Defects of the cranial vault bones are divided, depending on the size, into small, medium and large. Primary plastic surgery was performed in 3 patients, the rest at various times after the injury. A carbon implant of 2 types (contrasting, non-contrasting) was used as a plastic material. As a result of the treatment, good results were obtained in 52, satisfactory in 9 patients. Based on the results of the treatment, it was concluded that carbon implants are promising as a material for cranioplasty.

KEYWORDS: fracture of the cranial vault, bone defect, carbon implant, primary cranioplasty, delayed cranioplasty, reconstructive surgery.

RELEVANCE:

An increase in the number of severe craniocerebral injuries, the number of surgical interventions for volumetric brain lesions are accompanied by the formation of postoperative defects in the bones of the cranial vault of various sizes. Disorders of hemo- and liquorodynamics occur, which are combined under the concept of "trepanned skull syndrome". The reasons for disability in these cases arise from neurological and mental disorders. Surgical interventions for cranioplasty lead to the regression of these disorders. Despite the continuous development of new techniques and materials for the reconstruction of defects of the cranial vault, the problem of cranioplasty is still relevant (7, 9). Until now, there is no consensus and no algorithm for the choice of materials and timing of cranioplasty.

REQUIREMENTS FOR MODERN PLASTIC MATERIALS:

1.Biological compatibility;
2. Lack of carcinogenic effect;
3.Plasticity;
4. Possibility of sterilization and combination with adativny technologies; 5.Compatibility with neuroimaging techniques;
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.

PURPOSE OF THE STUDY:

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

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 (4.4%) 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 the repeated treatment of patients were: persistent headaches, neurological disorders (memory impairment, speech, aphasia), epileptic seizures, fear of re-traumatizing the brain, the presence of a cosmetic defect. All patients underwent a comprehensive clinical and instrumental examination, which included clinical and neurological, neuro-ophthalmological examination, examination by an anesthesiologist, consultation with an ENT specialist, craniography; 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 (4.4%) patients.

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.

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 joint to joint and fixed with bone sutures; The sutures were removed 8–10 days after the operation.

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 biocompatibility of carbon materials is high, which has been proven in clinical and experimental studies. Carbon-carbon composite material is produced by bonding carbon fibers with carbon in methane (CH4) medium when heated to a temperature above 1000 ° C. It is a graphite or carbon matrix reinforced with carbon fibers. Physicochemical properties of carbon-carbon and corundum implants, the strength properties of which, with a typical implant manufacturing technology, significantly decrease with decreasing material thickness, which does not allow modeling thin highly angular surfaces. The properties of carbon-carbon composite implants provide almost unlimited possibilities for their saturation with antiseptic or antibacterial drugs, this is facilitated by the porous structure of the carbon-carbon material. The property of slow gradual biodegradation (the ability of the material to be resorbed in an organic

environment) with osteoinduction (stimulation of the growth of the surrounding bone) is inherent only in carbon-carbon materials, which makes it possible to achieve the restoration of the maternal bone after plastic surgery of limited defects. The clinical efficacy of cranioplasty was assessed by analyzing the quality of life of patients using the standardized Glasgow outcome scale, generally accepted for patients in the intermediate and long-term TBI period.

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.

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. Consequently, the restoration of the tightness of the skull and the elimination of the cosmetic deficit 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 (70.192%) cases, in the absence of dynamics, both before and after surgery, slow-wave activity was recorded in the areas of the brain subject to the implant, which is 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 using drugs (iminostilbens) and was detected only during provocative tests. The cosmetic result was subjectively assessed by 54 (80.6%) patients as good, 9 (13.4%) - satisfactory, which is due to severe scar deformity of soft tissues. Reactive seroma occurred in 6 (8.9%) patients 3–7 days after the operation; one or two percutaneous aspiration was performed. The reaction of the tissues was due to a significant area of the wound surface and the need to mobilize extensive muscular-fascial flaps, to perform manipulations in the area of the basal venous collectors of the integumentary tissues of the head. Postoperative complications were observed in 9 (13.4%) patients, including hemorrhagic - in 1 (1.4%), infectious-inflammatory - in 8 (11.9%). Superficial wound infection was eliminated in 5 (3.3%) cases using 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.
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-carbon implants will allow the use of these implants at a high risk of inflammatory complications, however, additional studies are required to determine the concentration and toxicity of the drugs. 4. The introduction of a carbon-carbon composite material, an economically inexpensive bioinert material with a low profile and the possibility of saturation with antibacterial drugs, creates conditions for the use of this material in emergency and planned neurosurgery.

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