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Reconstruction of Defects in the Bones of the Cranial Capital at the Stage of Rehabilitation: The State of the Problem

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The number of patients with post-traumatic and post- trepanation defects of the cranial vault, who need to restore the integrity of the skull, is growing every year, due to an increase in the number of severe traumatic brain injuries, as well as an increase in indications for decompressive craniotomy associated with traumatic brain injury, vascular pathology, neurooncology for relief of hypertensive -dislocation syndrome (Fig. 1) [1–3]. In the future, with stabilization of the condition and the disappearance of the risk of herniation of the brain substance, the presence of defects in the bones of the cranial vault causes in patients the "trepanned skull syndrome", which includes headaches, including those associated with changes in environmental conditions, neurosis-like and depressive disorders, cosmetic defects in in the form of retraction of the skin flap in the area of the defect, as well as protrusion of intracranial contents into the trepanation window during physical exertion, coughing, sneezing, etc. Such patients need to restore the integrity of the skull not only for cosmetic, but also for therapeutic purposes [2 , 4].

Modern works on this topic have shown that cranioplasty after decompressive craniotomy can improve the patient's neurological status, especially if performed early after decompressive craniotomy, which is of great importance for further rehabilitation and its timing [5, 6]. Currently, the optimal time for plasty of defects in the bones of the cranial vault is the interval from 1 to 6 months after decompressive craniotomy [1, 4]. Despite the apparent simplicity of this operation, cranioplasty remains a rather laborious and painstaking procedure for maxillofacial and neurosurgeons, associated with a potential risk of complications [7–9].

Choice of implant material

Another topic actively discussed in modern scientific literature is the choice of implant material for cranioplasty . Plastic surgery of skull bone defects is possible with auto- ,allo-, or xeno -implants [4, 7].

The use of allo -implants for these purposes has now been discontinued, which is due to a greater number of postoperative complications than with other types of implantation (resorption, risk of rejection, risk of infectious infections, including human immunodeficiency virus, hepatitis, etc.), as well as ethical issues (use of the skull bones of deceased people).

Autobone for cranioplasty is still used today. However, the results of a number of studies show that, compared with synthetic materials, sterilized autologous bone has the highest percentage of purulent-septic complications after surgery. When repairing skull defects with autobone , there is also a risk of postoperative partial or complete resorption of the bone implant (with a probability of 25 to 50%). This is due to the fact that the body begins to perceive the sterilized autobone as foreign and “dissolves” it through the reaction of aseptic inflammation [2, 7, 10]. Considering these shortcomings, as well as the fact that it is not always possible to preserve autologous bone after decompressive craniotomy or traumatic brain injury with comminuted skull fractures, with the development of reconstructive surgery for the consequences of traumatic brain injury , synthetic materials have been developed and introduced into clinical practice for cranioplasty . , the so-called xenografts .

For xenografts currently used in cranioplasty , there are a number of requirements that define the "ideal" material. The implant must be strong enough to carry out a protective function in relation to the intracranial content; it must be absolutely biologically inert, exactly repeat the shape of the missing part of the skull bones, and also not cause purulent-septic complications or rejection reactions after surgery [1, 11]. Unfortunately, none of the currently used synthetic materials meets these conditions by 100% [1, 7, 11].

Historically, completely different synthetic materials have been used for cranioplasty, most of which, for objective reasons, are not currently used. Thus, aluminum was the first metal successfully used in the plastics of skull defects (Booth and Curtis, 1893). In various historical periods, steel, gold, silver, and tantalum were also used for these purposes, which had their own significant drawbacks and are not currently used. Of the synthetic materials for cranioplasty, titanium, polyether ether ketone (polyether ether ketone , PEEK), polymethyl methacrylate (poly (methyl methacrylate , PMMA) and hydroxyapatite [12–14].

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