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TO EVALUATE THE EFFECTIVENESS OF VARIOUS METHODS OF PLASTIC SURGERY OF POST-TRAUMATIC DEFECTS OF THE CRANIAL VAULT

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Abstract: **Target** The present work is a study of the significance of clinical and neurological symptoms and an assessment of the effectiveness of using various methods of plastic surgery for post-traumatic defects of the cranial vault.

Keywords: craniocerebral injury, temporo-parietal region, postmenopausal, Body composition, Fat mass, Lean mass, Aging.

1. Introduction

Craniocerebral trauma (CCT)is one of the most pressing problems of modern medicine, accounting for 35–40% of all injuries in peacetime. In combined injuries, the proportion of CCT reaches 70–72%. Clinical and neurological symptoms in CCT in general and in post-traumatic skull defects in particular are very diverse. Such patients experience general cerebral, focal, vegetative-somatic symptoms, and some patients develop epileptic seizures [3,4,6].

The problem of closing post-traumatic defects and restoring the integrity of the cranial vault has worried doctors since ancient times, and active work continues to this day on developing various methods of plastic surgery of cranial defects and searching for optimal methods of fixing transplants [1,2,5]. This issue remains the subject of close attention of all neurosurgeons since the establishment of neurosurgery as a separate medical discipline.

In the process of rehabilitation treatment, complete elimination or compensation of damage is considered optimal. In the presence of a trepanation defect in patients who have suffered a severe craniocerebral injury, pathogenetic therapy should be started with its plastic closure [4,8,9].

The optimal characteristics of any fixation system include: biological inertness of the material, reliability of fixation, absence of displacement between the transplant and the marginal structures of the skull, ease of use, moderate cost of the structure, as well as the absence of artifacts during neuroimaging, neurophysiological and other research methods. However, to date, none of the known methods of transplant fixation fully meets all these requirements [7,10,11].

The presence of a cranial vault defect, especially an extensive one, leads to the development of organic and functional disorders of the brain, as well as to hemodynamic and cerebrospinal fluid dynamics disorders. At the same time, the risk of injury to unprotected parts of the brain by external influences increases significantly [1,3,4,9].

Material and methods

This work is based on the analysis of the results of surgical treatment of 60 patients with post-traumatic defects of the cranial vault bones (PTCDBS) of various localizations who were

treated in the multidisciplinary clinic of the Samarkand State Medical University, in the department of neurosurgery, in the period from 2020 to 2025.

Among the analyzed patients, men predominated — 45 people (75.0%), women — 15 (25.0%). All patients had a history of traumatic brain injury (TBI).

The distribution of patients by the location of the cranial defect is as follows: in the frontal-parietal region - in 48.5% of patients, in the frontal-temporal region - in 42.9%, in the temporo-parietal region - in 56.4%, in the frontal-parietal-temporal zone - in 8.6% of patients (Diagram No. 1).

According to the size of cranial defects, patients were divided into 3 groups: small defects (up to 30 cm²) in 24 patients (40%), medium defects (30–60 cm²) in 32 patients (53.3%), large defects (>60 cm²) in 4 patients (6.7%) (Table 1).

Diagram 1

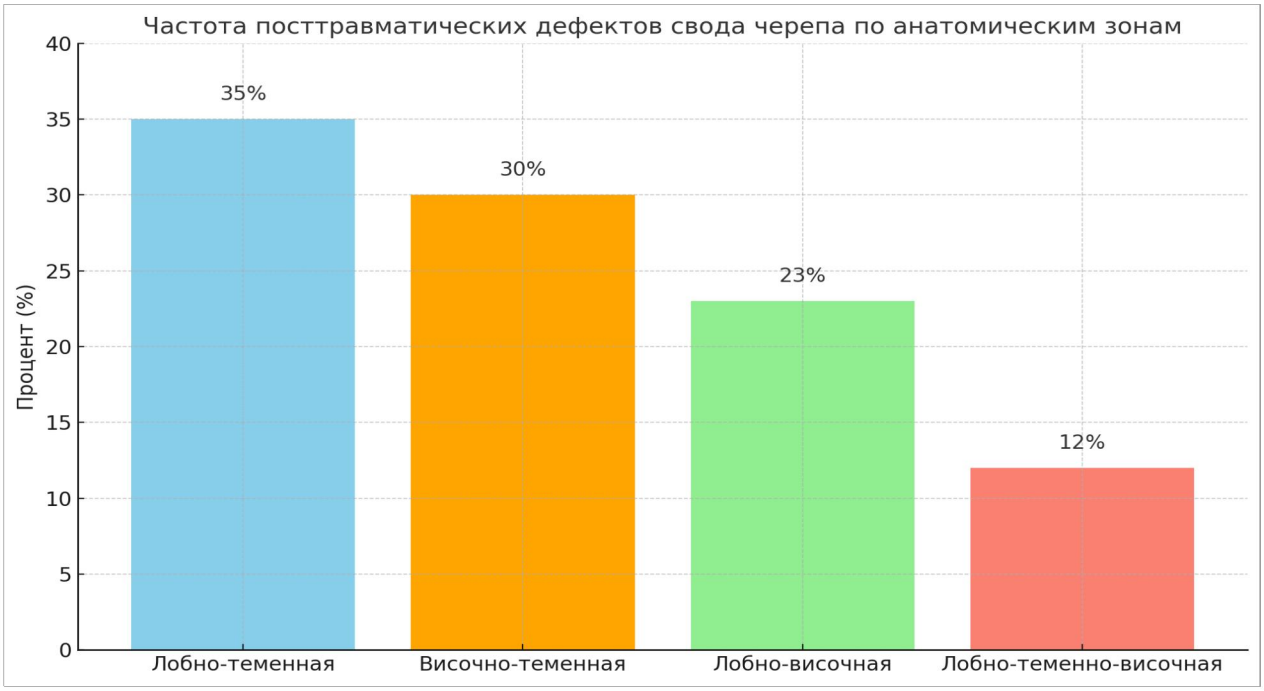


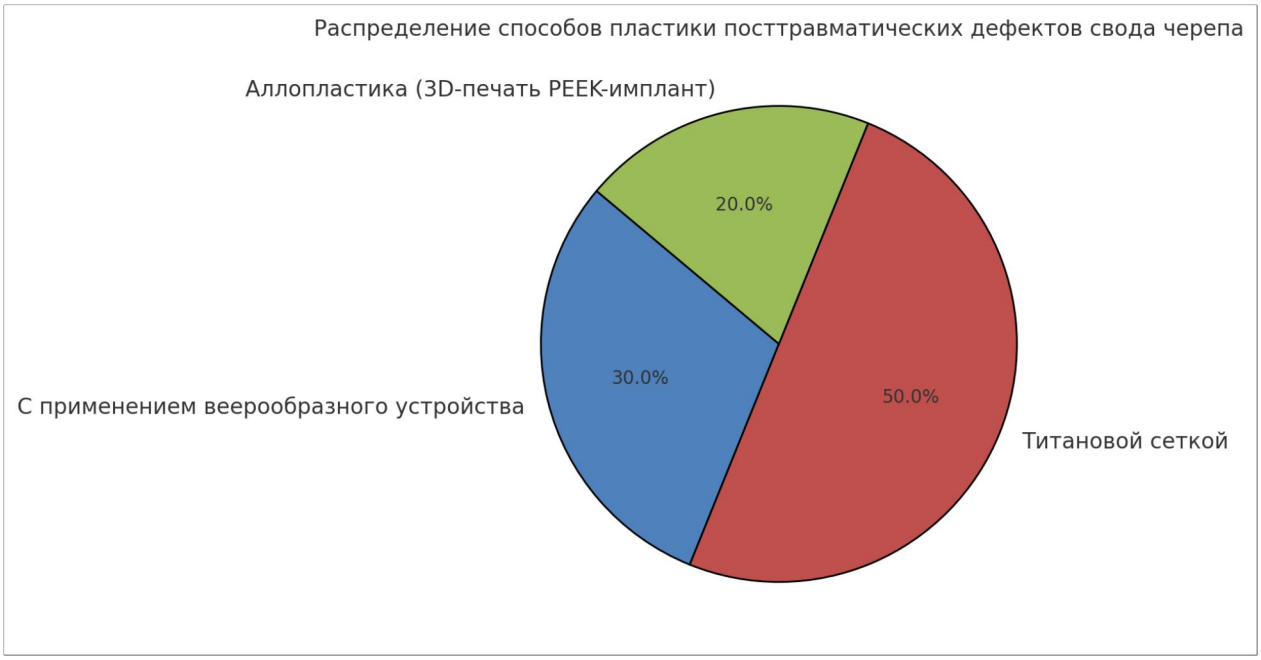
Table 1

Sizes of bone defects	Number of patients	%
small (<30 cm2)	24	40
medium (30-60 cm2)	32	53.3
large (>60 cm2)	4	6.7
Total	60	100

Of the 60 patients with PDKSCH, 22 (36.7%) underwent autoplasty of cranial vault bone defects using a fan-shaped titanium device, in 28 (46.7%) patients alloplasty was performed using a titanium mesh, in 10 (16.7%) patients alloplasty was performed using a computer modeling 3D printing PEEK (polyether-ether-ketone) implant (Diagram No. 2).

All patients underwent a comprehensive examination, including clinical, neurological, and radiological examinations using modern research methods (EEG, multispiral computed tomography with 3D reconstruction of the skull, and magnetic resonance imaging).

Diagram #2



Distribution of patients according to methods of plastic surgery of skull defects.

Results and discussion

In 25% of patients, cranioplasty was performed within 1 year after the injury and resection trepanation of the skull, and in the remaining 75% of patients, cranial defect plastic surgery was performed after 1 year. The neurological picture of the trepanned skull syndrome (TSS) included cephalgia (98.4%), meteolability (88.4%), decreased ability to work (47%), memory loss (72%), impaired intellectual function (38%), bulging of the underlying brain tissue into the trepanation window (72%), mental changes associated with cosmetic issues and constant fear of brain injury (88%), epileptic seizures (36.8%). Focal symptoms were observed in the form of hemiparesis, central paresis of the facial nerve, amovrosis, hyposmia, anosmia, and myopia. Hemiparesis was observed in 17.5%, central facial nerve paresis on the right in 15.4%, on the left in 12.4%, amaurosis in 5%, hyposmia in 5.6%, anosmia in 8.6% and amblyopia in 12.4%.

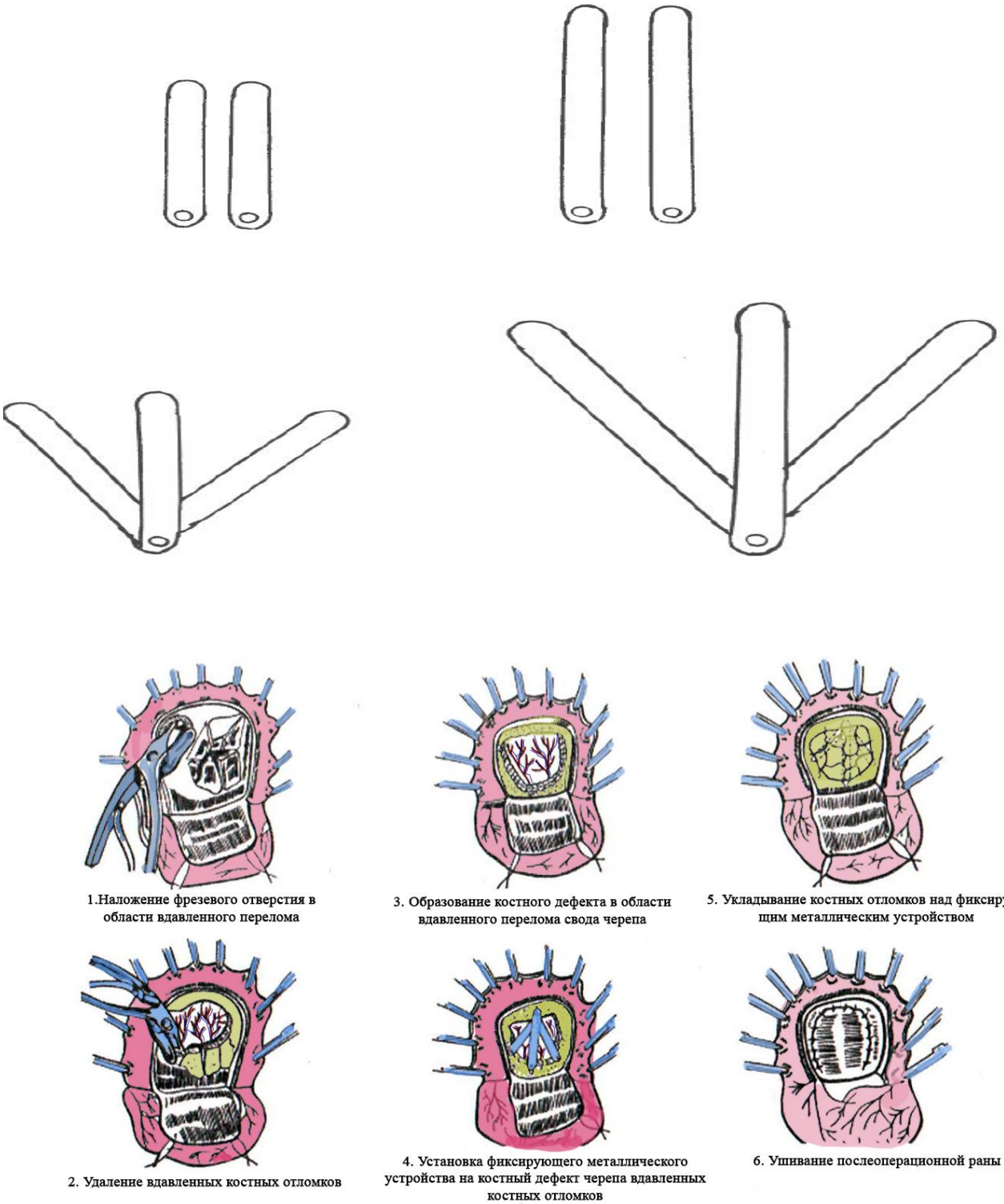
In case of post-trepanation skull defects, especially in case of defects after surgery for depressed cranial vault fractures and intracranial hematomas, various methods of plastic surgery are widely used: autoplasty, xenoplasty, alloplasty, etc. The best method, of course, is autoplasty of skull defects. Professor Mamadaliev A.M. and co-authors have developed and implemented in practice (patents for inventions have been received) methods of primary and secondary autoplasty of cranial vault defects using a fan-shaped titanium device.

In the first and second groups, surgical intervention began with excision of the skin scar and release of the edges of the bone defect.

The fixing fan-shaped device consists of several identical titanium plates, hinged together. The ends of the plates are rounded and at one end of each plate there is a hole for mutual fixation. A stainless steel rivet used in medicine is used as a plate fixator. As an option, the hinge connection can also be carried out using stainless steel wire or thick silk. The plates have different sizes. Their length can be up to 150, width - up to 20 mm and thickness up to 2 mm. The size and number of plates depend on the size of the bone defect of the cranial vault. In the working state, the device has the shape of a "fan".

The free ends of the plates were installed in the "grooves" made between the outer and inner plates of the skull bone along the edge of the defect. The number of grooves depended on the

number of plates. The hinged end of the device was placed on the opposite side of the bone defect on the made recess on the outer plates of the bone. Bone fragments removed during trepanation were evenly and tightly placed over the fan-shaped device. These fragments were prophylactically treated with an antiseptic solution. The postoperative wound was sutured tightly.



Этапы операции аутопластики дефектов свода черепа с применением вееробразного титанового устройства.

The best results were noted in autoplasty of bone defects of the cranial vault. No purulent complications were noted in these groups of patients. However, 1 of 22 patients experienced

various complications after the operation, such as transplant rejection.

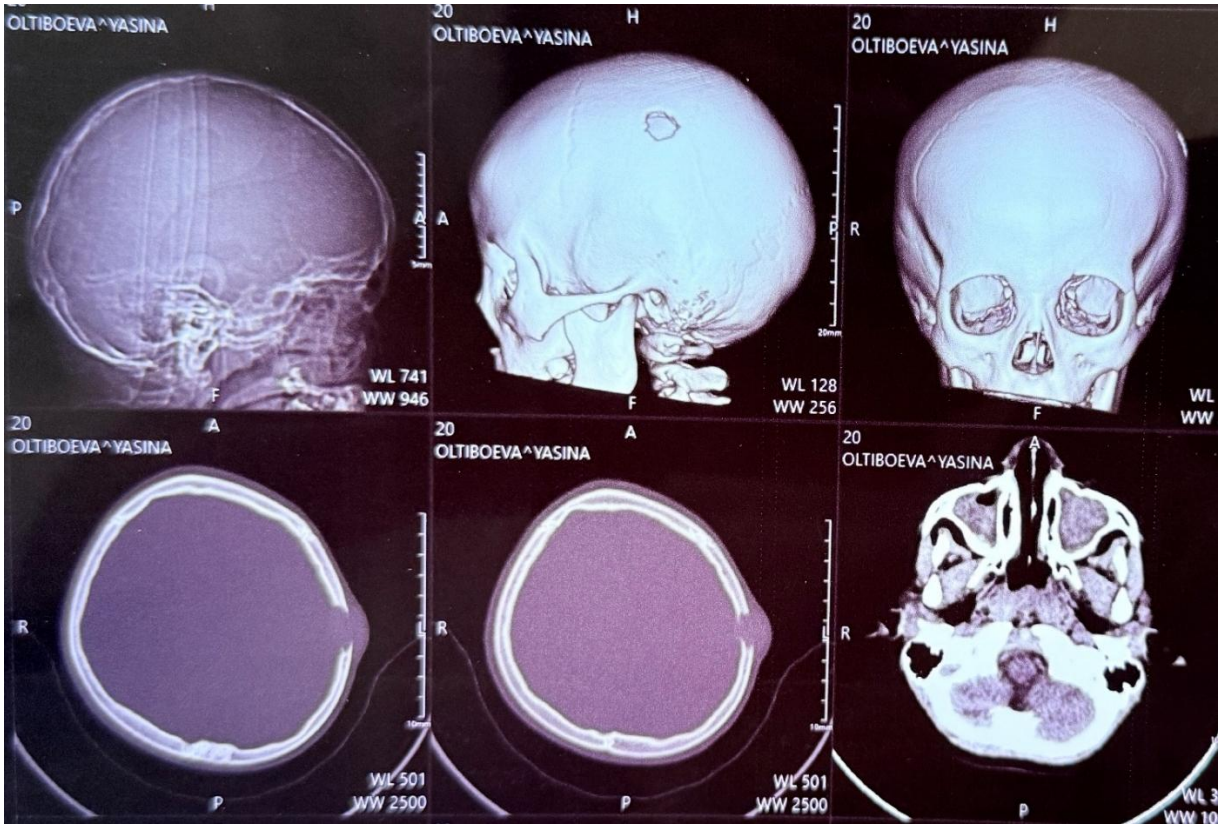


Fig. 1: MSCT examination of a patient with a depressed fracture of the left temporal bone

Fig. 2: Intraoperative photos 1,2. Installation of a FAN-shaped titanium plate

Of the 28 patients who underwent secondary allocranioplasty, 4 (14.3%) patients experienced various complications in the form of transplant rejection, suppuration of the postoperative wound, and osteomyelitis of the edges of the bone defect, which ultimately required removal of the transplants.

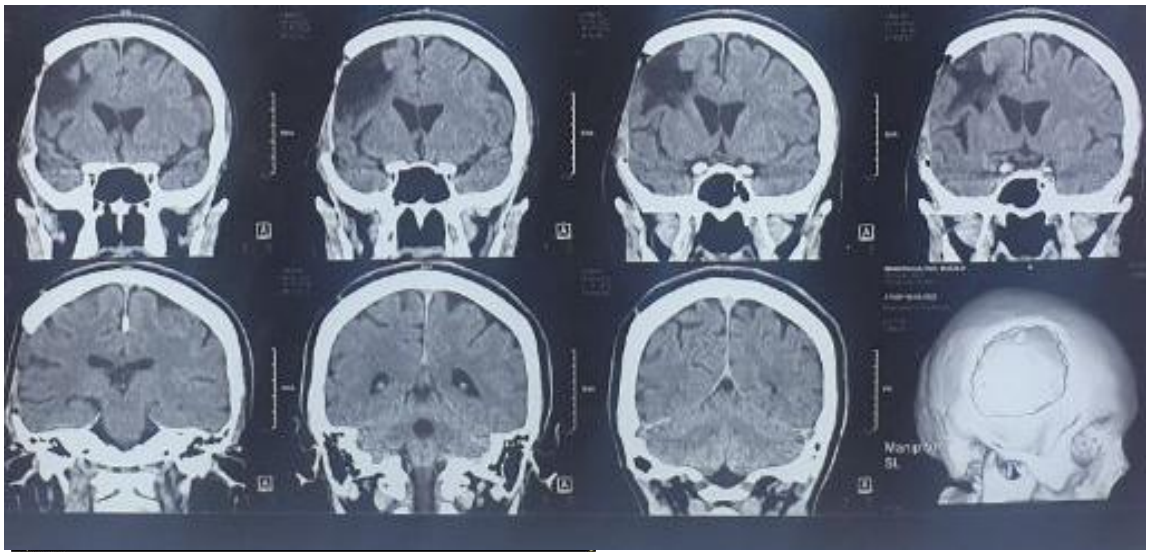


Fig. 3: MSCT examination of a patient with a bone defect in the frontotemporo-pa

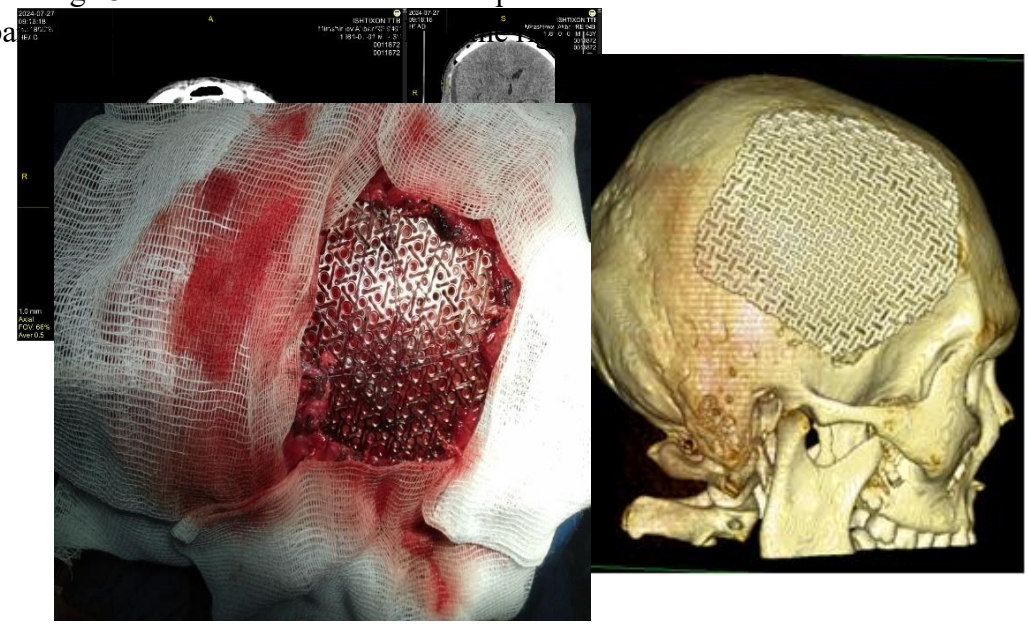


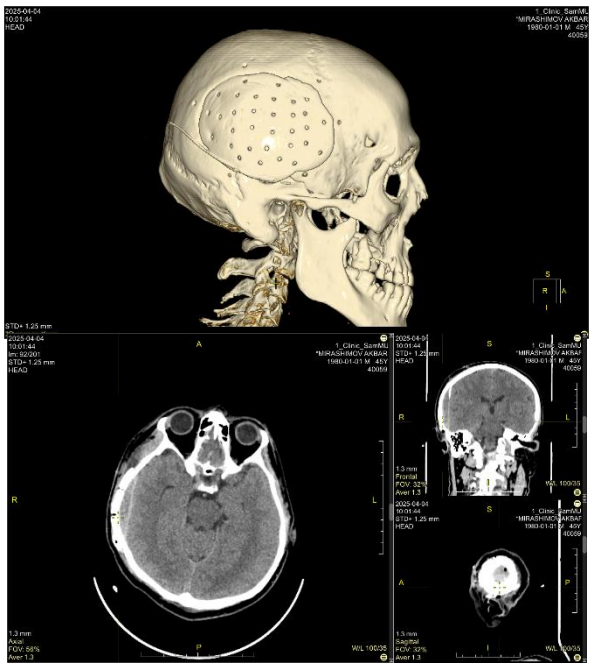
Fig. 4: Intraoperative photos (condition after installation of titanium mesh); and MSCT (after surgery) of patient V. Condition after alloplasty with titanium implant in the right frontal-parietal-temporal region.

Installed implants from PEEK (polyether-ether-ketone) Using 3D computer modeling technology, the integrity and shape of the skull is completely restored.

Of the 10 patients who underwent secondary allocranioplasty with an implant made of PEEK(polyefer-efer-ketone) various complications such as transplant rejection, suppuration of the postoperative wound and osteomyelitis of the edges of the bone defect, which ultimately required removal, were not observed

transplants.

Fig 5: MSCT examination of a patient with a bone defect in the frontal-parietal-temporal region of the cranial vault on the right., Intraoperative photos (skeletonization of the bone defect and installation of an implant).



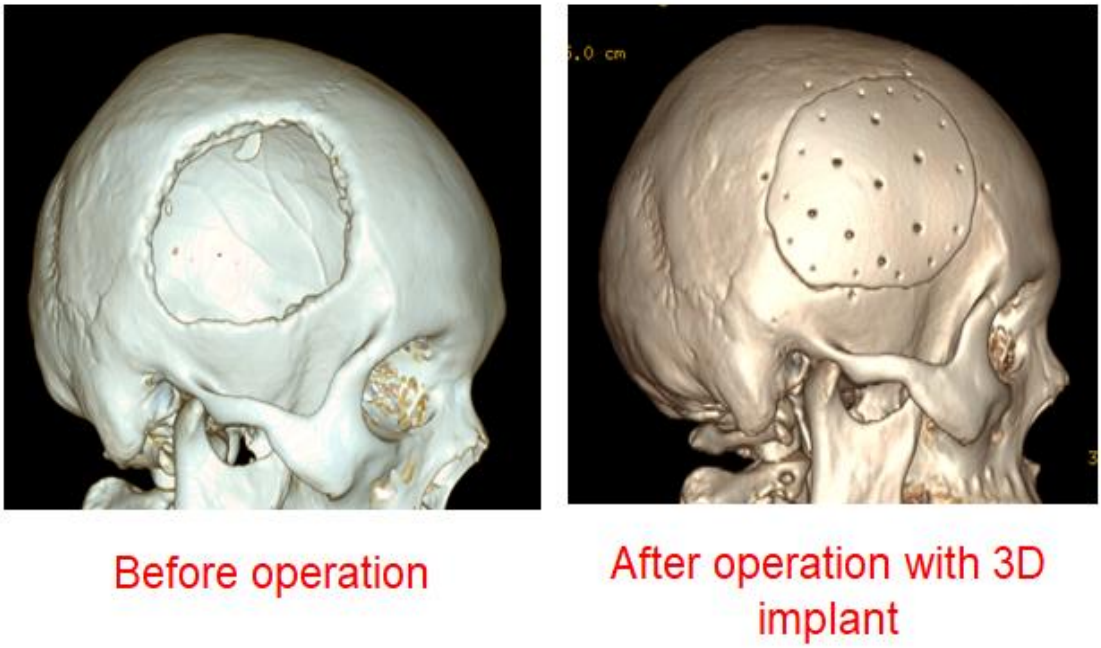


Fig. 6.3D MSCT of patient M.A. Condition before and after surgery; Postoperative defect vault of the skull on the right. Using 3D implants for plastic surgery of the bone defect of the cranial vault on the right.

In all cases, a satisfactory cosmetic effect was achieved. At the time of discharge, the patients had no complaints - there was no pain in the area of the transplant, the scar was soft, painless, the skin color was unchanged, there was no swelling, and the symmetry of the skull was preserved.

The control examination did not reveal any deviations in the neurological status of patients in both groups. In 58 (96.7%) patients, the pain syndrome regressed. In all cases, a good cosmetic result was achieved. Upon palpation, the grafts did not differ from the surrounding bones of the patients, symmetry was preserved in all cases. Repeated craniography in patients of the first group did not reveal changes in the bone structure at the site of fixation and adjoining of the plates to the bones of the skull.

Conclusions

The conducted studies have shown that the use of implants made of titanium mesh optimizes the task of eliminating complex skull defects, reduces the trauma and duration of the operation, and provides a predictable good functional and cosmetic result.

The use of computer 3D modeling allows for the closure of skull bone defects of any size and configuration, and in the postoperative period, the best cosmetic and functional results are achieved, since the designed 3D implant is maximally identical to the contours of the bone defect. The implant is manufactured before the operation, thus significantly reducing the duration of the surgical intervention and reducing the risk of infectious complications.

The use of the autocranioplasty method using a fan-shaped fixing device in patients in the acute period of TBI and in the late period of traumatic disease with existing defects of the vault bones has shown its high efficiency. The advantage of this type of plastic surgery over others is that the patient's own bone tissue is used as a plastic material. The simplicity of the metal device,

its fixation in the area of the bone defect, the ease of subsequent removal and the possibility of performing autocranioplasty in any neurosurgical hospital - all these positive qualities also showed the advantages of this method over other types of plastic surgery.

References.

1. Belchenko, V.A. Reconstruction and endoprosthetics of the edges and walls of the orbits, bones of the cranial vault, upper and middle zones of the face / V.A. Belchenko // Proceedings of the III Congress of Neurosurgery. Ross. - St. Petersburg, 2002. - P. 634.
2. Gaidar, B.V. Practical neurosurgery: Manual for physicians. / Edited by B.V. Gaidar. - St. Petersburg: Gipppokrat, 2002. - 648 p.
3. Gusev, E. I. Neurology and neurosurgery: textbook: in 2 volumes / E. I. Gusev, A. N. Konovalov, V. I. Skvortsova; edited by A. N. Konovalova, A. V. Kozlova. - M.: GEO-TAR-Media, 2009. - T. 2: Neurosurgery. - 420 s.
4. Konovalov, A. N. Clinical guidelines for traumatic brain injury / A. N. Konovalov, L. B. Likhterman, A. A. Potapov. - M., 2002. - 675 p.
5. Levchenko, O. V. Modern methods of cranioplasty / O. V. Levchenko, V. V. Krylov // Neurology. - 2009. - No. 1.
6. Mamadaliev A.M., Agzamov M.K. Prevention of posttraumatic arachnoiditis in the acute period of severe TBI. Problems of morphology and parasitology named after Sechenev. M. 1992. p. 296.
7. Mamadaliev, A. M. Prediction of outcomes of traumatic brain injury in the acute period. Diss. MD. M. 1988.
8. Mamadaliev, A. M. Yuldashev Sh. S. Device for autoplasty of cranial vault defects. Problems of medicine. Abstracts of reports of scientific conference dedicated to the 600th anniversary of M. Ulugbek. Samarkand department. Academy of Sciences of the Republic of Uzbekistan. medical department. 1994. – p. 41-42.
9. Mamadaliev, A. M. Yuldashev Sh. S. Device for autoplastic surgery of cranial vault defects. Patent for invention of the Russian Federation N2050833 dated December 27, 1995.
10. Mamadaliev A.M., Yuldashev Sh.S. Results of primary autoplasty in depressed fractures of the cranial vault. Abstracts of reports of the 1st Congress of Neurosurgeons of the Russian Federation. Ekaterinburg. 1995.
11. Mamadaliev A.M., Shakhnovich A.R., Abakumova L.Ya. Prognostic value of quantitative assessment of impaired consciousness in dynamics. Medical journal of Uzbekistan. 1987. No. 6.-p. 18-22.
12. Potapov, O. O. Dosvshch daily closure of defects at the source of the skull / O. O. Potapov, O. P. Dmitrenko, O. P. Kmita // IV Congress of Neurosurgeons of Ukraine: abstract. report D., 2008. - P. 23.
13. Tanaka, Y. Development of titanium fixation screw for hydroxyapatite osteosynthesis (APACERAM) / Y. Tanaka // Surg neurol. - 2008. - Vol. 70, No. 5.- P. 545-549.
14. Wilkinson, HA Cranial bone fixation / HA Wilkinson // J. Neurosurg. - 2004. -Vol. 100, No. 6. - Pl 134-1135.
15. Sahoo N, Tomar K, Thakral A, Rangan N. Complications of Cranioplasty. J Craniofac Surg. 2018 Jul;29(5):1344-1348. doi: 10.1097/SCS.0000000000004478.

16. Thawani JP, Pisapia, JM, Singh, N., Petrov, D., Schuster, JM, Hurst, RW, Zager, EL, Pukenas, BA, 2016. 3D-Printed Modeling of an Arteriovenous Malformation Including Blood Flow., World neurosurgery. Elsevier Inc. doi:10.1016/j.wneu.2016.03.095

17. Yeap MC, Tu PH, Liu ZH, Hsieh PC, Liu YT, Lee CY, Lai HY, Chen CT, Huang YC, Wei KC, Wu CT, Chen CC. Long-Term Complications of Cranioplasty Using Stored Autologous Bone Graft, Three-Dimensional Polymethyl Methacrylate, or Titanium Mesh After Decompressive Craniectomy: A Single-Center Experience After 596 Procedures. World Neurosurg. 2019 May 10. pii: S1878-8750(19)31279-3. doi: 10.1016/j.wneu.2019.05.005.

18. Zanaty M, Chalouhi N, Starke RM, Clark SW, Bovenzi CD, Saigh M, Schwartz E, Kunkel ES, Efthimiadis-Budike AS, Jabbour P, Dalyai R, Rosenwasser RH, Tjoumakaris SI. Complications following cranioplasty: incidence and predictors in 348 cases. J Neurosurg. 2015 Jul;123(1):182-8. doi: 10.3171/2014.9.JNS14405.

19. Zanotti B, Zingaretti N, Verlicchi A, Robiony M, Alfieri A, Parodi PC. Cranioplasty: Review of Materials. J Craniofac Surg. 2016 Nov;27(8):2061-2072. doi: 10.1097/SCS.0000000000003025.

20. Stula D. The problem of the “sinking skin-flap syndrome” in cranioplasty // Journal of maxillofacial surgery. - 1982. - T. 10. - P. 142-145.

21. Zegers, T., ter Laak-Poort, M., Koper, D., Lethaus, B., & Kessler, P. (2017). The therapeutic effect of patient-specific implants in cranioplasty. Journal of Cranio-Maxillofacial Surgery, 45(1), 82-86.

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