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Scalp Defect of Cranioplasty with Titanium Mesh: A Case Report

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Abstract: Several implant materials for cranioplasty have been studied, including autologous bone, titanium mesh, polyetheretherketone (PEEK), and polymethyl methacrylate (PMMA). Titanium mesh is believed to have excellent biocompatibility, low cost, and satisfactory cosmetic effects, especially in three-dimensional (3D) custom-made meshes. We reported a 54-year-old man complaining of open wound in his left temporoparietal region since a month. Blood tests showed leukocytosis. Patient was diagnosed as scalp infection with previous cranioplasty using bone cement on temporoparietal region. The patient underwent scalp reconstruction with skin flap, removing skin defect, and split thickness skin graft (STSG) from left thigh. Patient was provided with outpatient medication consisting of analgesics and broad-spectrum antibiotics. Follow-up assessment 14 days after surgery did not reveal any secondary infections on titanium mesh implant and skin flap. The main complications of cranioplasty, in addition to the studied aesthetic results, are represented by the risk of infection, postoperative hematoma, impaired wound healing, as well as prolonged failure due to transplant absorption or infection, as a result of which the prosthesis needs to be removed. In conclusion, titanium mesh is still a better choice of material for cranioplasty in many factors such as price, accessibility, infection rate, and biocompatibility
Keywords: scalp; cranioplasty; head injury; prosthesis

INTRODUCTION

Cranioplasty (CP) is a delayed neurosurgical procedure used to reconstruct a cranial defect in patients who have undergone decompression craniotomy (DC) to treat trauma, intracranial hemorrhage, or intracranial hypertension due to neoplasms.[1] Cranioplasty has been routine in the neurosurgery department for decades and can not only provide protective and cosmetic benefits, but also provide significant neurological and cognitive improvements.[2,3] However, CP faces many challenges that surgeons should focus on to avoid reoperation, such as choosing the right implant material, optimal timing, and reducing post- and postoperative complications.[4-5] Patients discharged from hospital should be followed-up to assess long-term construction effects, particularly changes in the shape of the repair site.

Several implant materials for CP have been studied, including autologous bone, titanium mesh, polyether-ether-ketone (PEEK), and polymethyl methacrylate (PMMA).[6-7] Considering the limitations of autologous bone grafting, such as lack of graft sources and unpredictable bone resorption, it was found that autologous bone grafting was insufficient for the recovery of some patients, especially those with large cranial defects. Therefore, homogeneous plastic materials such as titanium mesh, PEEK, PMMA and other homogeneous plastic materials may be better choices. Titanium mesh is believed to have excellent biocompatibility, low cost, and satisfactory cosmetic effects, especially in three-dimensional (3D) custom-made meshes.[8] Titanium fabrics can be used alone or in combination with other synthetic materials to reinforce the prosthesis. Being a metal alloy, titanium has high overall strength and malleability. Titanium is non-corrosive and non-flammable, has a low risk of infection, and can provide excellent cosmetic results.

We present the case of a 54-year-old man with a history of cranioplasty 23 years ago and implantation of a titanium mesh to replace bone cement implant 11 months ago due to bone expose in that area.

CASE REPORT

A case of 54-year-old man complained of open wound in his left temporoparietal region. The patient had previous cranioplasty procedure with bone cement installation 23 years ago due to an epidural hematoma. However, since the patient experienced exposed bone in temporoparietal region 11 months ago. he underwent implantation of titanium mesh to replace the bone cement implant. The patient also complained of itching in the wound defect. During general examination the sign of scalp infection in left temporoparietal was found with a size defect of 10 cm x 10 cm (Figure 1). Blood investigations and all other lab results were normal, except for leukocytosis. The patient was diagnosed as scalp infection with previous cranioplasty using bone cement. The diagnosis and management were discussed with the patient; therefore, the patient underwent scalp reconstruction with reimplantation of titanium mesh and skin flap using split thickness skin graft (STSG) from left thigh (Figure 2 A-E). The patient was educated to come for follow-ups to the outpatient department. Follow-up was carried out 14 days after discharge (Figure 3). The wound area looked good, and there were no ports of entry, necrotic areas, edema, and other signs of secondary infection. Neurological examination revealed no abnormalities. The patient showed satisfying improvement with titanium mesh reimplantation and STSG, and no secondary post-operative infections.

DISCUSSION

The reconstruction of head defects has two main objectives: to ensure the protection of the brain and to restore appropriate cosmetics. The result should be long-lasting. The main complications of cranioplasty, in addition to the studied aesthetic results, are represented by the risk of infection, postoperative hematoma, impaired wound healing, as well as prolonged failure due to transplant absorption or infection, as a result of which the prosthesis needs to be removed.[9]

Theoretically, the ideal material for cranial reconstruction is autologous lobes, since there are no problems with biocompatibility, the shape of which is optimal for the restoration of

ordinary cosmetics, ensuring immediate and adequate protection of intracranial structures. However, despite the difficulty of properly arranging the bone lobes, it has been found (in some literature reviews) that even autologous bones have a relatively high failure rate in terms of infection or resorption.[10-12]

Titanium mesh is one of the most commonly used homogeneous materials in cranioplasty due to its low infection rate, low cost, and good mechanical strength. In addition, titanium fabrics prefabricated by three-dimensional computed tomography can bring good appearance.[13] Nevertheless, titanium fabrics also have some drawbacks, proving that some patients have metal allergies and need to use alternative materials. Erosion of the overlying soft tissues and exposure of the implant are another complication.[14] Finally, titanium mesh is easily deformed by external forces.

Figure 1

Figure 2A

Figure 2B

Figure 1. Pre-operative clinical appearance. Evaluation of bone cement installation 23 years ago after high speed blunt trauma, and symptoms of pain and itching in the wound area. There was necrotic tissues and bone cement exposed around the implant due to loss of follow-up.

Figure 2C

Figure 2D

Figure 2E

Figure 2. Intra-operative clinical appearance (Day 1). A, Depressed defect measuring 10cm x 10cm after bone cement implant due to high-velocity injury in the left temporoparietal area; B, Edema and bruising around the wound indicating a secondary infection in the wound area found on first day examination; C, Transpositional skin flap with supraorbital pedicle; D, Cleaning of necrotic tissue and pus followed by replacement of the implant bone cement with a titanium mesh; E, Stitching the wound area and ensuring there is no port of entry for further infection

Figure 3. Outcome (Day 14). Inspection assessment did not reveal any secondary infections, flap assessment did not reveal necrotic tissue and signs of further infection. From left to right: back view, front view, right-side view, and left-side view

Titanium cranioplasty consists of a pre-curved mesh (adapted to the individual patient) and a custom-made prosthesis specially reconstructed for each individual patient using computer-aided design/computer-aided manufacturing techniques. It can be done in two ways. The two prostheses differ in cost and result. There is a great deal of literature on titanium cranioplasty with custom-made prosthetics, but relatively few papers discuss the use of pre-curved mesh. Therefore, we compared these two types of prostheses.[15]

Polyetheretherketone (PEEK) is now widely used in practice and has the advantages of being biocompatible, chemically inert, and radiolucent. In addition, bespoke patient-specific PEEK implants can be designed using computer-aided 3D technology and can also be used for complex craniofacial reconstructions.[16] Despite these benefits, PEEK implants are expensive, epidural exudate after cranioplasty bothers many surgeons, and one study speculates that the exudate is due to a delayed allergic reaction.

Retrospective analysis of titanium mesh and custom implants for Rosinsky et al. cranioplasty showed that patients who underwent custom implant cranioplasty developed significantly higher infection rates than tendency-matched patients who underwent titanium mesh cranioplasty. This increased risk leads to recommending the use of titanium mesh implants when considering both titanium implants and custom implants. Patients undergoing titanium cranioplasty should be aware that they may experience discomfort at the site of the implant, but this should not mask the increased risk of infection associated with custom implants.[17]

Matsuno et al[11] showed that titanium mesh has the lowest graft infection rate of all cranioplasty materials of 2.6%. In addition, computer-aided 3D modeling can be used to design titanium mesh implants that provide excellent cosmetics even for major defects in the skull.[12] In a systematic review study of allogenetry, Oliver et al[18] found that PMMA implants were associated with the highest infection rates. Meanwhile, polyether-ether-ketone implants were associated with significantly higher local complication rates and the highest ultimate graft failure rates compared to all other implant types.[17-18]

Moreover, Van de Vijfeijken et al[12] conducted a literature review with 10346 articles on a total of 228 cranioplasty procedures. Infection was the most common complication (about 6% of the total). In their review, autologous bone and PMMA infection rates were the highest (6.9% and 7.8%, respectively) compared to HA (3.3%) and titanium (5.4%).

In our case, the patient had previous re-implantation of titanium mesh 10 month ago because bone expose in his temporoparietal region which 23 years ago had cranioplasty. The patient complained of itching in his scalp, and we found infection in his scalp with open wound in size 10 cm x 10 cm. There are many causes of scalp infection in this patient. The previous defect of skin, uncontrolled patient to outpatient department, the wound care, and nutrition may lead to infection.[4] Comprehensive education has performed to the patient after surgery, and he was provided with outpatient medication consisting of analgesics and broad-spectrum antibiotics to prevent surgical site infection. Assessment 14 days after surgery did not reveal any secondary infections, and flap assessment did not reveal necrotic tissue and signs of further infection.

CONCLUSION

This case presents the successful replacement of a bone cement implant with titanium mesh followed by a transpositional flap, with no secondary infections found and complete flap repair 14 days after surgery. Empirically, there is no ideal material for cranioplasty; however, a material that is strong, resistant to infection, radiolucent, inexpensive, easy to use, and can be combined with the patient's craniotomy defect will provide the greatest benefit to that patient. Titanium mesh remains a better material choice for cranioplasty.

Conflict of Interest

The authors affirm no conflict of interest in this study.

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