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Multiple Delayed Scalp Reconstruction for Complicated Cranial Defects

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Summary: In cases of skull trauma, emergency surgery for cranial decompression typically involves the shortest approach, with the incision lying directly on or immediately near the bony defect. Subsequent reconstructive plastic surgery for the skull is difficult in such cases because incisions taken on the previous scar overlying the bony defect are prone to dehiscence and infection. Herein, we describe a technique for creating a well-vascularized delayed skin flap via multistaged operation before the actual skull reconstruction. Four patients (age range, 10–25 y) were prepared for skull reconstruction using this technique. Flap elevation was performed in 3 stages, with adequate time intervals (4wk between each stage) to allow for adequate delay. Dissection under the galea aponeurotica was performed only after initial flap elevation allowing for adequate vascularization. Skull reconstruction was then performed using custom-made implants. The patients were followed up for 6 to 12 months. No complications, including infections, exposure of the artificial bone, or flap necrosis, were observed. All the patients were satisfied with the cosmetic results. Despite the multiple stages required, we consider that our technique of using a delayed, well-vascularized bipedicled skin flap can be successfully used in the skull reconstruction of patients in whom the initial scar lies close to the bone defect. We recommend scalp incision be shifted outside of the foreseen bony flap to limit infectious risks during primary or subsequent cranial reconstruction.
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Cranial defects may result from a variety of causes, including trauma, neoplasia, congenital malformations, or any neurosurgical interventions. For skull reconstruction, such as that required after brain surgery, the team of plastic surgeons carefully evaluates the details of skin incision, proposed bony flap (location and extent), and subsequent reconstruction with the involved neurosurgeons in a preoperative conference. However, in cases of skull trauma, the immediate need to lower intracranial pressure mandates emergency decompressive craniotomy to be performed by neurosurgeons, allowing very little time to discuss these points. In such cases, plastic surgeons perform skull reconstruction after the patient condition is stabilized. In emergency cranial surgery, the shortest approach is often used, in which the skin incision is on or very near to the bony defect. In our experience, approaching reconstruction via the previous scar in these cases can sometimes lead to infection and wound dehiscence, with exposure of the artificial bone.

For such complicated cases, we proposed a multistaged method for creating a delayed skin flap in preparation for the actual skull reconstruction.

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PATIENTS AND METHODS

A consecutive series of patients who needed skull reconstruction with a previous scar over the bone defect or close to the edge of the defect were included.

The new skin incision was taken such that its distance from the bony defect's edge is greater than 2 cm. Then, the skin was incised in multiple stages.

In the first stage of the operation, every other half incision was made, reaching the galea aponeurotica. No further dissection was performed under the galea; rather, it was simply cut and closed.

In the second stage, which was performed 4 weeks after the first, a similar process was performed for the remaining halves of the incision that were not cut in the first stage.

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Four weeks after the second stage, a full-length incision was made, with dissection to the edge of the cranial defect and elevation of the flap. If the vascularization of the delayed flap was considered adequate, further dissection was performed about 1 cm from the defect's edge. On the other hand, if the vascularization was considered to be suboptimal or inadequate, the dissection was delayed for 4 more weeks. This delayed bipedicled modified bicoronal skin flap was thus ready after the 3-step operation.

Skull reconstruction using custom-made artificial bone was performed 4 weeks after the bipedicled skin flap was prepared, with an approach from the preparing incision.

RESULTS

This technique was applied to 4 patients with ages ranging from 2 to 25 years (average, 12.8 y). The causes of the skull defect were trauma in 3 patients and cranioplasty for craniosynostosis in 1 patient. All patients needed 3-step operations for preparing the bipedicled flap. During the follow-up period, no complications, including infections, exposure of the artificial bone, or necrosis of the flap, were observed except in 1 patient. The delayed flap of this patient was successful, but the expansion of the scalp caused by the skull reconstruction caused flap congestion and wound dehiscence.

Representative Case

A 21-year-old woman experienced a traumatic skull fracture during overseas travel and underwent an emergency operation locally. As a result, she had a left frontotemporal bony defect, with a scar just above its rim.

A delayed bipedicled bicoronal skin flap was prepared using the 3-step operation previously described. In the fourth stage, a custom-made polyetheretherketone implant (KLS Martin, Tuttlingen, Germany) was implanted (Fig. 1). Postoperatively, the patient experienced no complications and was satisfied with the result.

DISCUSSION

A variety of techniques have been described for covering cranial defects, including skull reconstructions with the material from the patient's own body (autologous), implants of natural origin (allogenic), and artificial (alloplastic) substitutes, including hydroxyapatite cement,

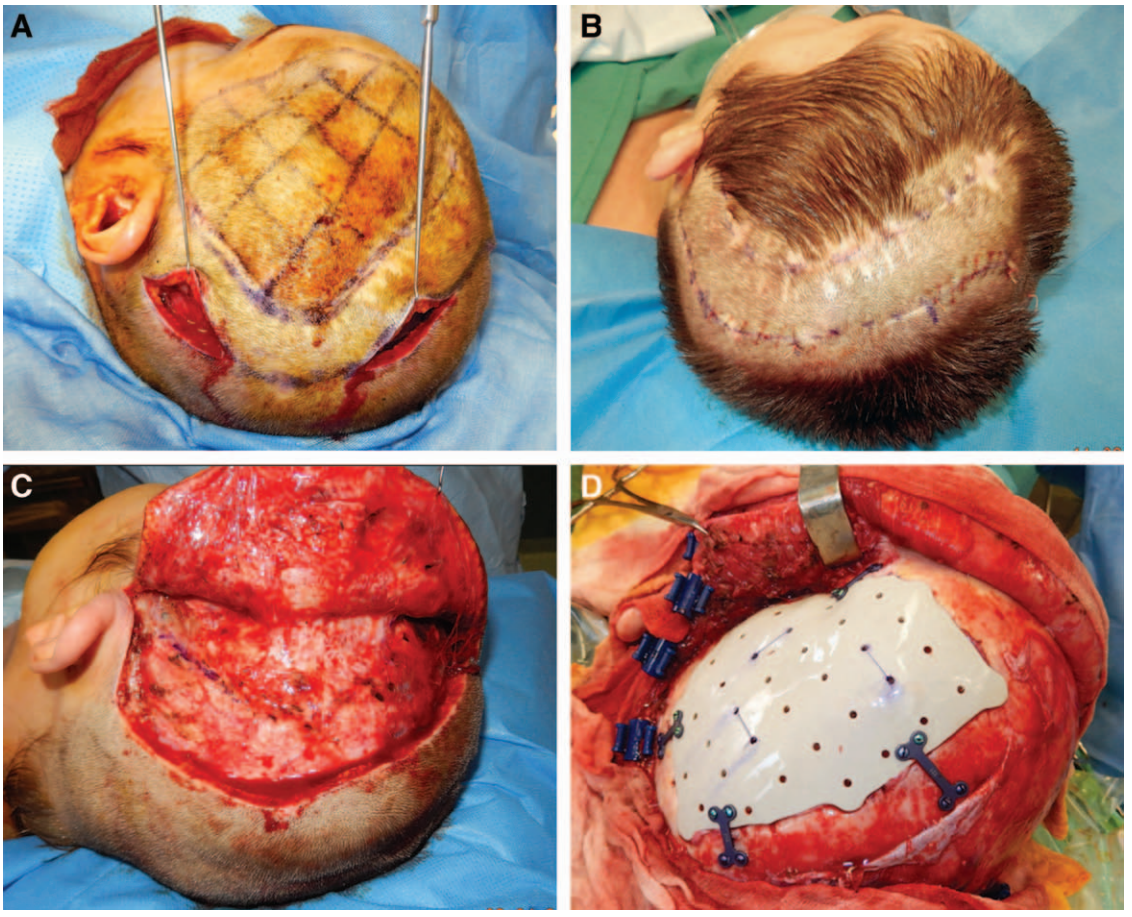

Fig. 1. A 21-y-old woman with a left frontotemporal defect. A, Intraoperative view of the operation's first stage. Note that every other half incision was made. B, Postoperative view immediately after the operation's second stage. Note that the remaining half of the incision was made and sutured. C, Intraoperative view of the operation's third stage. Note that a full-length incision was made, with dissection to the edge of the cranial defect and elevation of the flap. D, Intraoperative view of the operation's fourth stage. Note that a custom-made implant was used to fill the defect.

polymethyl methacrylate, polyether ether ketone, and titanium.[1–6] Various reports have described the complications related to cranioplasty and the associated risk factors.[7,8] These studies have concluded that a history of previous infection at the surgical site is more important in determining the outcome irrespective of the choice of the reconstructive material. To the best of our knowledge, no reports have examined the risk expected from the previous scar anatomically overlying the bony defect.

We believe that many surgeons experience the situation where the previous scar lies on, or very close to, the bony defect, which renders skull reconstruction difficult.

Physical stress causing wound dehiscence when approaching skull reconstruction through a previous incision is to be considered. Well-vascularized microvascular soft-tissue transfers below the incision may be particularly useful to prevent wound dehiscence, which may cause postoperative exposure of the reconstructed bone.[9,10] However, the disadvantages of this technique include donor-site morbidity and prolonged operative time.

In our method, we did not approach reconstruction through the previous scar. Accordingly, the scar remained a "scar" and was not transformed to a "wound," thus remaining strong against the physical stress of reconstructive surgery. This led to a lower risk of wound dehiscence. However, the area between the new and the previous incisions became a closed area or a bipedicled skin flap. Performing this random flap across a scar increases the risk of acute ischemia when it is elevated in a single stage. To increase its chances of survival with stable vascularization, the extended neoflap should be elevated in stages as a delayed flap.

The disadvantage of our technique was the number of stages required for preparing a well-vascularized flap. However, each stage was short, lasting approximately 10–15 minutes. Furthermore, these preparatory operations could be performed under local anesthesia; therefore, we consider that the operative and patient burdens were not high.

In conclusion, our multistaged delayed cranial reconstruction with a bipedicled flap is an easy and effective method for treating complicated cranial defects.

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