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Cranioplasty with bone flaps preserved under the scalp

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Abstract

Cranial bone defects in 27 patients were repaired with bone flaps preserved under the scalp. Head trauma (thirteen patients), cerebrovascular disorder (five patients), postoperative brain swelling (seven patients), and cerebral infective disease (two patients) accounted for the cranial defects. The bone flaps are reimplanted after 14–98 days. The follow-up period was 6 to 26 months. We have encountered no complications releated to this technique in 27 consecutive cases.

Keywords: Autograft, cranioplasty, craniotomy, skull bone flap.

1 Introduction

Brain swelling has plagued neurosurgeons since the beginning of neurosurgery. It occurs in patients with head injuries, thrombotic and, hemorrhagic strokes, brain tumors, and in fact, any space-occupying intracranial lesion, and is the most common cause of death in these patients. The goals of treatment are to reduce intracranial pressure in order to increase cerebral blood flow above the critical level required for oxygenation of the brain and to relieve herniation.

Despite the availability of numerous methods to treat the brain edema, removing bone flaps is often be necessary for decompression [7, 8, 10, 13]. After this procedure, the cranial defect should be repaired for many reasons. Decisions concerning the methods of cranioplasty are somewhat difficult, owing to the multiplicity of methods available, each with its own set of advantages and disadvantages. However, the best source of autogenous membranous bone is the bone removed from the site of the initial operation, if the bone flap can be preserved. In this paper, we present data from 27 patients with cranial defects repaired with bone flaps preserved under the scalp.

2 Materials and methods

A total of 43 patients with various cerebral disorders associated with brain swelling were operated on in our clinic between January 1991 and June 1993. The bone flaps were removed during craniotomy and the dural opening was closed with a graft of pericranium. The removed bone flaps were preserved under the scalp until reimplantation (Figure 1). All patients were treated for increased intracranial pressure with hyperventilation and mannitol. 16 patients who died of primary cerebral disorders (mostly cerebral infarcts or severe head injuries) were excluded from the study.

Our series consisted of 20 male and 7 females; the average age of the patients was 31 years (range 3 to 65 years), and the average length of follow-up was ten months (range six to twenty-six months).

The causes of the increased intracranial pressure were the following: head trauma (18) (cerebral contusion, acute subdural hematoma, and traumatic intracerebral hematoma), cerebrovascular disorder (13) (cerebral infarct and primary intracerebral hematoma), postoperative brain swelling (8) (tumor, aneurysm, and arteriovenous malformation) and cerebral infective disease (4) (subdural empyema, cerebral abscess and encephalitis).

When swelling of the brain was resolved, the bone flaps were removed from their position under the scalp by using the same craniotomy incision (Figure 2). All bone flaps seemed grossly normal. After dissection of the normal bone edges and separation from the dura, the bone flaps were reimplanted and affixed with absorbable vicryl sutures. The previous burr-hole defects were filled with bone mash obtained from the inner table of the skull flap (Figure 3). The bone flaps were replaced after 14–98 days, with the mean duration of preservation being 43 days.

3 Results

Sixteen of the fourty-three operated patients died due to primary cerebral disorders. In five of these patients, postmortem examinations were performed, and all of the flaps were found in good condition. Microscopic examination showed that the bone plates were alive (Figure 4) and X-ray studies showed normal density of the bone plates (Figure 5).

In all recovered patients, the bone flaps preserved were reimplanted after the patient's neurological status stabilized and cerebral edema resolved.

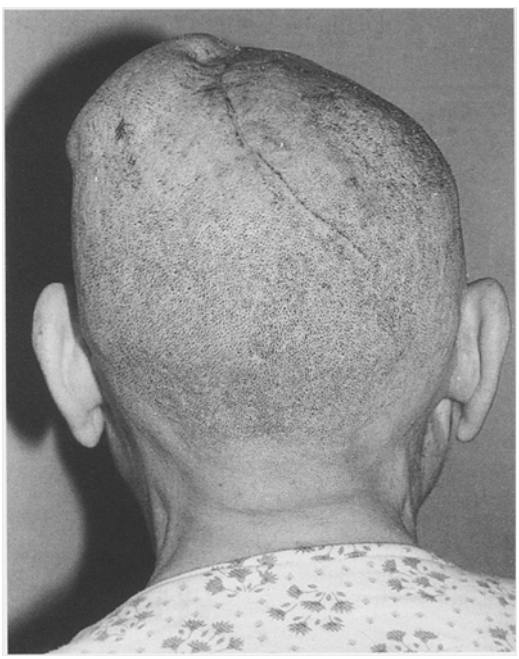

Figure 1. The appearance of the bone flap under the scalp three weeks after decompressive craniotomy.

No complications such as infection or resorption occured during the follow-up period, and excellent cosmetic results were obtained.

4 Discussion

In patients experiencing intracranial hypertension cranioplasty should be postponed until brain edema resolves and the patient's neurological condition has stabilized [9]. It is well known that alloplastic flaps always remain foreing bodies and may be rejected even after many years [4, 16, 17], autogenous living bone, however, represents the optimal material for repair of cranial defects [1, 3, 12, 16]. Autogenous endochondral and membranous bone are excellent substitute materials for cranioplasties [2, 15]. However, rib and iliac crest bone grafts are difficult to shape into the desired configuration and the har-

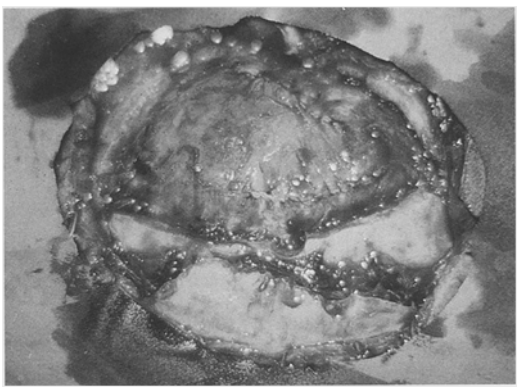

Figure 2. The appearance of the bone flap preserved (arrow) under the scalp and craniotomy area.

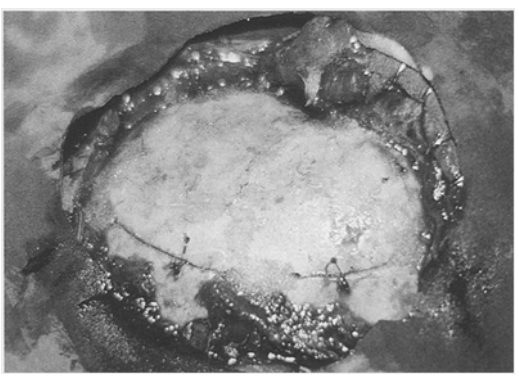

Figure 3. The appearance of the operative area after completed cranioplasty.

vested calvarial bone, although it withstands resorption better than rib or iliac bone, may not be sufficient to fill large cranial defects [16]. Besides, any of these methods needs additional incisions. Therefore, the most suitable material in delayed repairing of a cranial defect is the preserved original autogenous bone flap fitted in its original position. Many studies have been reported on the preservation and re-use of bone flaps.

Methods have included placing the plates in various solutions [6], storing the bone after radiation [11], sterilizing with heat [15], deep freezing [1, 3, 14, 15], and conserving bone flaps under the abdominal wall [13]. All of these techniques posses some limitations such as unacceptably high rate of resorption, infection, unavailability of facilities for handling and storage, and need for additional incisions [5].

The technique for preserving the bone flap under the scalp is first described by *Korfalı* and *Aksoy* [9]. Thereafter, *Zhu* [18] reported his experience in six patients.

The survival of the flap depends on the invasion of capillaries from surrounding tissues. The bone flap preserved under the scalp thus maintains its vascularization and vitality for a long period, and the risk of infection in such a well-vascularized bone flap is low [9, 18]. We have encountered no bone resorption or infection in any of our cases, and no patient complaint of disturbing or unpleasant sensations during the preservation period.

In conclusion, our experience has shown that this technique is a simple, practical, and economical way for delayed grafting and is the best choice under certain circumstances.

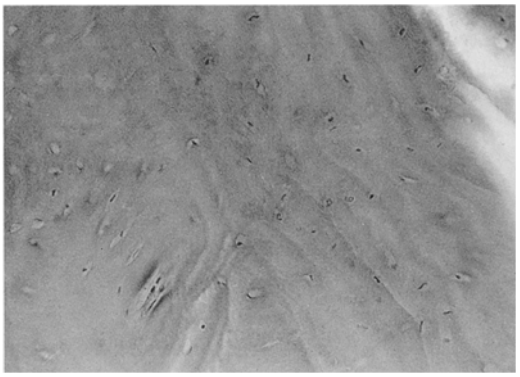

Figure 4. A close appearance of bone trabecules in autogenous bone graft. The bone trabecule kept its lamellation and osteocyts appear alive (Hematoxylin and eosin, × 400).

Figure 5. Right lateral view showing the preserved bone graft 22 months after replacement.

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