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CASE REPORT

Craniofacial/Pediatric

Bone Flap Preservation in Subcutaneous Abdominal Pocket for Decompressive Craniectomy

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Summary: We report our experiences of two pediatric cases in which a bone flap was preserved in the subcutaneous abdominal pocket for decompressive craniectomy. In one case, the bone flap was divided and preserved for cranioplasty without complications; in the other case, the bone flap was left intact as one piece. In pediatric patients, the storage space for a bone flap is sometimes difficult to achieve, and the technique described herein is useful in such situations. Notably, because the bone resorption rate with cryopreservation is higher in pediatric patients, in vivo preservation may be more useful in this population. *(Plast Reconstr Surg Glob Open 2022;10:e4432; doi: 10.1097/GOX.0000000000004432; Published online 20 July 2022.)*

For the treatment of intracranial hemorrhage, decompressive craniectomy is often performed. To reduce intracranial pressure, a cranial bone flap is removed. The bone defect is reconstructed with an autogenous bone or artificial material after the brain edema has improved. In pediatric cases, an artificial material may not match the skull growth, resulting in gaps and bumps. Another drawback is that an artificial bone is prone to infection. Conversely, an autogenous bone grows in response to surrounding bone growth and has a small risk of infection. If an autogenous bone is used, it must be preserved until cranioplasty.

Although there are various methods of preserving a bone flap, no consensus has been reached on the best approach. Additionally, there is a need for studies that evaluate the clinical outcome of the patients who undergo reimplantation of the bone flap and assess the status of the bone and its relationship with the tissue processing and storage conditions.[1]

In this study, we described two pediatric cases in which a bone flap was preserved in the subcutaneous abdominal pocket and reported the results by comparing with other studies.

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CASE REPORTS

Case 1

A 1-month-old infant was evaluated for traumatic subdural hematoma. The patient underwent craniotomy, hematoma removal, and external decompression. The bone flap (dimension: 64 cm^2) was easily preserved on the left lower quadrant with sufficient space while performing head surgery. An incision was made following the relaxed skin tension line, and the bone flap irrigating normal saline was preserved on the investing layer of the deep fascia. On postoperative day 33, when the brain was not atrophied too much and settled within the cranium, the bone flap was removed; no complications of infection or bone resorption were observed; and cranioplasty was performed. The bone flap was fixed with an absorbable plate. Antimicrobials were administered intravenously during surgery and for several days postoperatively. At 17 months after cranioplasty, computed tomography showed no significant bone resorption, and no postoperative infection occurred.

Case 2

A 19-month-old child was evaluated for traumatic right subdural hematoma. The next day, left intracerebral hemorrhage was observed, and craniotomy and external decompression were performed. The bone flap (dimension: 110 cm^2) was large, divided into four pieces, and then stacked and stored on the left abdominal fascia (Fig. 1). On postoperative day 23, the bone flaps were removed, and cranioplasty was performed in the same way (Fig. 2). Computed tomography 2 months after cranioplasty and X-ray 19 months after cranioplasty revealed no significant bone resorption, and no postoperative infection occurred (Fig. 3).

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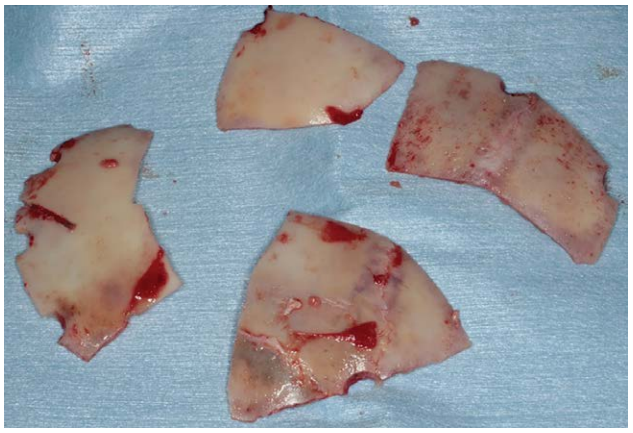

Fig. 1. Case 2: subdural hematoma in a 19-month-old child. During decompressive craniectomy, the bone flap is divided into four pieces and stored in a stack on the left abdominal fascia.

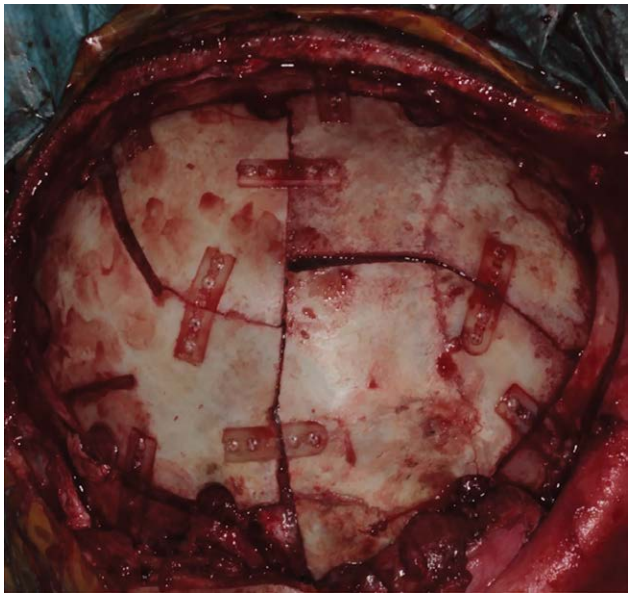

Fig. 2. During cranioplasty, the bone flaps are well preserved, and the divided bone flaps are fixed with plates and used for cranioplasty.

DISCUSSION

The two approaches to preserving a bone flap removed for external decompression are in vivo preservation and ex vivo preservation. In vivo preservation includes subcutaneous femoral and subcutaneous abdominal preservation, and ex vivo preservation includes cryopreservation and alcohol preservation.

Several studies of bone flap preservation evaluated storage methods and the rates of infection and bone resorption. Infection and resorption of a bone flap can necessitate reoperation, which is a critical comparison point for preservation methods.

Several studies comparing in vivo preservation with cryopreservation showed the usefulness of in vivo preservation. A 2016 systematic review comparing infection and bone resorption rates for in vivo and cryopreservation methods showed no significant difference between

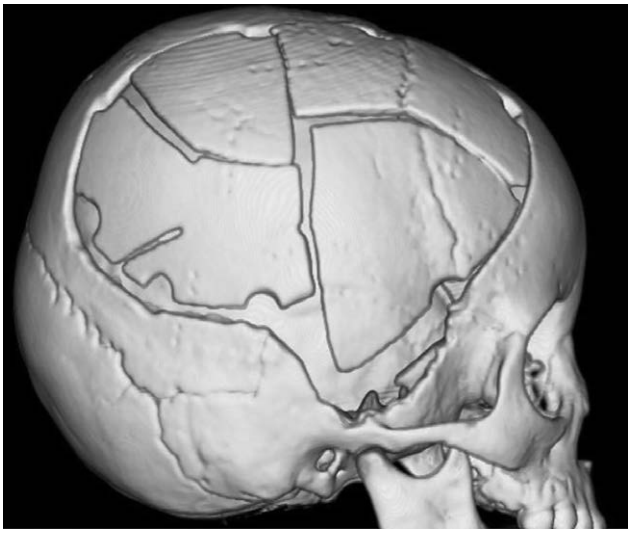

Fig. 3. A computed tomography scan 2 months after cranioplasty indicated no resorption of the bone flaps.

methods, with an infection rate of 7.08% and bone resorption rate of 7.69% for in vivo preservation versus 7.32% and 9.66% with cryopreservation, respectively.[2] Similarly, no substantial differences in infection rates between in vivo and cryopreservation methods were reported in a systematic review by Yadla et al.[3] Another study reported no significant difference in infection rates between in vivo preservation and cryopreservation; however, the infection rate with in vivo preservation was significantly lower in traumatic brain injury.[4]

In contrast to adults, pediatric patients are more prone to complications such as infection and bone resorption. A study of 40 pediatric patients treated with cryopreservation showed a high probability (50%) of bone resorption, to the point of requiring reoperation.[5] Another study of bone resorption by age reported a significantly higher rate in younger patients.[6] This study also compared in vivo and cryopreservation methods in pediatric patients and found no significant difference in infection or bone resorption rates. However, the number of in vivo preservation cases was extremely small, and these results must be further validated. Because few reports have addressed pediatric in vivo preservation, comparison of these results to those of other studies is difficult.

The current cases were managed by in vivo preservation, and the cases progressed without infection or bone resorption (Table 1). In pediatric patients, creation of an in vivo space to preserve the bone flap can be difficult because the head is larger than the trunk. However, reducing storage space requirements is possible by dividing and stacking bone flaps, as in our subdural hematoma case. In cranioplasty, divided bone flaps can be fixed to each other with a plate to maintain strength. One case report described preservation of bone flaps in layers, as in our case; that report also showed good results without complications.[7]

Disadvantages of in vivo preservation are creation of a new wound for preservation and pain during preservation;

Table 1. Summary of Two Pediatric Cases of Bone Flap Preservation in a Subcutaneous Abdominal Pocket for Decompressive Craniectomy

Case	Age	Sex	Injury	Preservation	Period (d)	Complications (Infection, Resorption)
1	1 mo	F	Traumatic subdural hematoma	On the left abdominal fascia	33	N/A
2	19 mo	F	Traumatic subdural hematoma	On the left abdominal fascia (four divided)	23	N/A

F, female; N/A, not available.

however, this approach does not require the time and freezer space needed for cryopreservation or maintenance costs for storage. No reports have documented higher infection or bone resorption rates with in vivo versus cryopreservation methods; thus, in vivo preservation can be actively considered as a good approach. Furthermore, cryopreservation methods vary from facility to facility, and one facility reported 60% significant osteolysis.[8]

The short follow-up period in our cases is a limiting factor; therefore, continued monitoring for complications such as bone resorption is required.

CONCLUSIONS

The in vivo method is an excellent approach to bone flap preservation with almost the same complication rate as that for the cryopreservation method. In addition, in the current study, neither infection nor bone resorption was observed in the case in which the bone flap was divided and stored in a layer on the abdominal fascia, and good progress was achieved after cranioplasty.

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