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Fundamental Neurosurgery

Cranioplasty with subcutaneously preserved autologous bone grafts in abdominal wall—Experience with 75 cases in a post-war country Kosova

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Abstract

Background: The study is to show the advantages of preservation of a calvarial bone flap in the abdominal pocket after decompressive craniotomy. Decompressive craniectomy is an option in the surgical management of refractory hypertension when maximal medical treatment (sedation, drainage of cerebrospinal fluid, moderate cooling, etc) has failed to control refractory high intracranial pressure.

Methods: We have prospectively analyzed 82 consecutively operated cases decompressive craniotomies done at the University Neurosurgical Clinic in Prishtina/KOSOVA over a period of eight years (June 1999 to Aug 2008). Of the 75 who had their grafts replaced (7 patient died before replacement of bone graft), 62 patients had hemicraniectomy (fronto-parieto-temporal) 7 of them were bilateral.

Results: In 66 out of 75 patients was achieved a satisfactory and cosmetically reconstruction, in 9 cases was required augmentation with methyl methacrylate to achieve cosmetic needs. Two patients had infection and the bone was removed; 6 months later these patients had cranioplasty with methyl methacrylate. The duration of storage of calvarial bone in abdominal pouch before reimplantation was 14 – 232 days (range 56 days).

Conclusion: We think that storage of the patients own bone flap in the abdominal pocket is a safe, easy, cheap, sterile, histocompatible, and better cosmetic results.

Key Words: Autogenous bone, bone flap, cranioplasty, subgaleal pocket

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INTRODUCTION

Decompressive craniectomy can be defined as the removal of a large area of the skull with opening of the dura to increase the volume of the cranial cavity, facilitating a reduction in intracranial pressure. Decompressive craniectomy is an option in the surgical management of refractory hypertension when maximal medical treatment (sedation, drainage of cerebrospinal fluid, moderate cooling, etc) has failed to control refractory high intracranial pressure, especially in brain trauma, stroke, and post-operative edema after brain

surgery. The technique of storing the craniectomy graft in a subcutaneous location in the patient offers a theoretical advantage in that the patient's own body might provide a storage environment, thereby reducing graft devitalization.[2,6,8,9] Autologous calvarial bone graft has been widely accepted as the best and safest method for reconstruction and also provides the best cosmesis.

Various preservation techniques include deep freezing, preservation in bactericidal solutions, sterilization, and preservation in a subgaleal pouch.[1,10,11] The cosmetic outcome of some of these is poor because of the adverse effects of the technique on graft preservation.[1,5,10,11]

In 1920, Kreider[9] reported the first case of preservation of calvarial bone in the left hypochondrium. This was in a 4-year-old boy who had sustained a compound skull fracture. Destination of a bone flap after craniotomy has many possible fates.

The aim of the present clinical study was to assess the efficacy of preservation of calvarial bone in an abdominal pouch.

MATERIALS AND METHODS

We have prospectively analyzed 82 consecutively operated cases decompressive craniotomies done at the University Neurosurgical Clinic in Prishtina / KOSOVA over a period of 8 years (June 1999 to Aug 2008). Of the 75 who had their grafts replaced (7 patient died before replacement of bone graft), 62 patients had hemicraniectomy (fronto-parieto-temporal), 7 of them were bilateral. The rest of the 13 patients required smaller craniectomy for decompression. Dura was always opened in a stellate fashion and after brain herniation it was closed with fascia pericranialis. Six patients were thin, 57 were normal, and 12 were obese. The mean age of patients was 39 years (range, 1 to 68 years). Male were 49 and female were 33. Out of 82, children were 16. Etiology of brain swelling requiring decompressive craniectomy in 82 patients is listed in Table 1.

Table 1: Etiology of brain swelling requiring decompressive craniectomy

		N	%	*P* value
Total		**82**	**100.0**	
Gender	Female	33	40.2	*P*=0.077
	Male	49	59.8	
Age	Mean ± SD (year)	39 ± 10.9		
	Range	1 - 68		
	< 18 year	16	19.5	
Etiology of brain swelling	Trauma	54	65.9	
	Aneurysm rupture	11	13.4	
	Stroke	8	9.8	
	Arteriovenous malformation rupture	4	4.9	
	Tumor post resection	4	4.9	
	Infection	1	1.2	
Bone grafts	Replaced	75	91.5	
	Died before replaced	7	8.5	

In the region of mesogastrium of left abdomen, we performed a linear horizontal incision with length between 8 and 12 cm (depend on the size of bone graft). With surgical scissors, we prepare the so-called abdominal pocket. After meticulous surgical hemostasis, we placed the bone graft with the convex part on upper site, because the bone edges can injure the skin. Under skin and skin are sutured with interrupted sutures. We do not prefer the right sight because in the future the scar might suggest the procedures like cholecystectomia or appendectomia.

Presentation of a case: Figure 1. Cranial defect before graft replacement. Figure 2. Bone graft in abdominal pocket. Figure 3. Taking the bone out of abdomen. Figure 4. Quality of bone after six months. Figure 5. Three weeks after replacement of bone flap – perfect surgical/cosmetically results L/L view. Figure 6. Three weeks after replacement of bone flap – perfect surgical/cosmetically results A/P view.

The post operative evaluation was based on adequacy of the recovered craniotomy graft to achieve satisfactory reconstruction.

RESULTS

In 66 out of 75 patients was achieved a satisfactory and cosmetically reconstruction, and in 9 cases was required augmentation with methyl methacrylate to achieve cosmetic needs. During surgery the temporo-basal region was removed in small pieces with rongeurs the part that required augmentation with methyl methacrylate. Two patients had infection and the bone was removed; 6 months later these patients had cranioplasty with methyl methacrylate. The duration of storage of calvarial bone in an abdominal pouch before reimplantation was 14 – 232 days (range 56 days).

At the time of cranioplasty done and after a few months, we did not encounter microscopic resorption of the bone flap in any of our patients. The average of GCS on admission was 6 (range 3 - 15). After calvarial bone replacement hematomas occurred in 4 patients: 3 were subgaleactic and 1 in abdominal pouch, there was no need for percutaneous aspiration. After the onset of symptoms and mass effect on computed tomography, timing of decompressive craniectomy was 1 – 6 h (range 2 hours). Involvement of dominant hemisphere was in 51 cases. Average extra time required for preparing abdominal pouch to insert calvarial bone was 14 min (range 9 – 21 minutes) average size of bone was 9 × 11cm (range 8 – 12 × 10 – 13).

Figure 1: Cranial defect before graft replacement

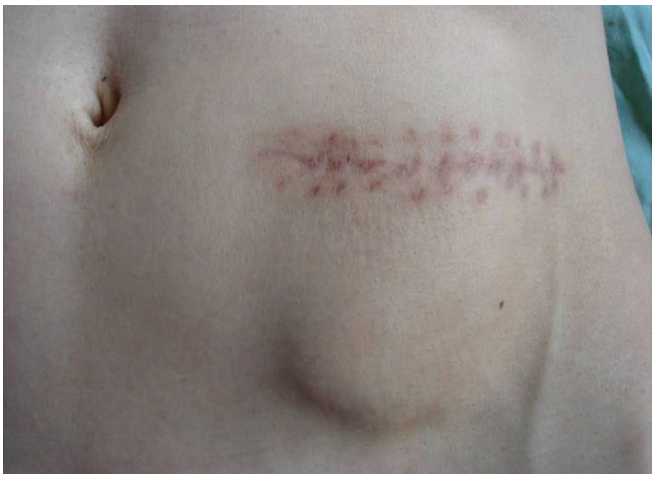

Figure 2: Bone graft in abdominal pocket

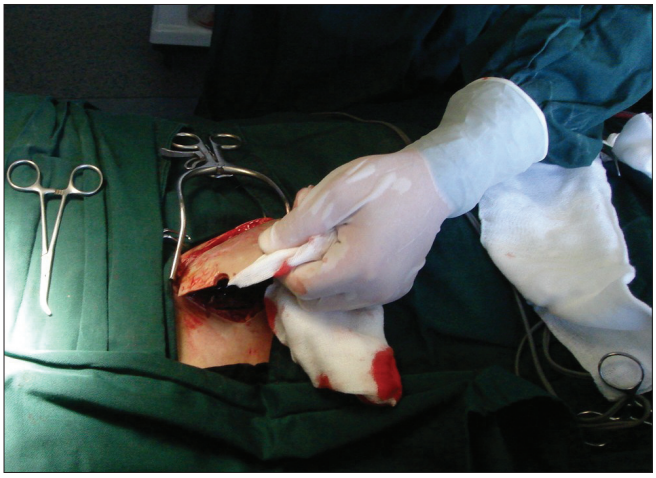

Figure 3: Taking the bone out of abdomen

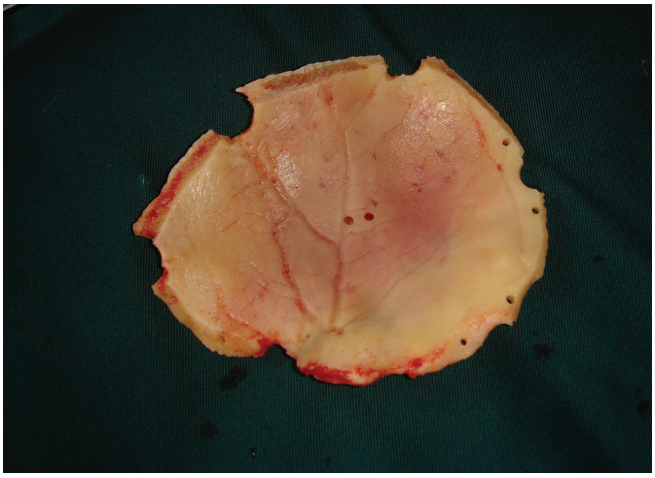

Figure 4: Quality of bone after six months

Figure 5: Three weeks after replacement of bone flap – perfect surgical/cosmetically results L/L view?

Figure 6: Three weeks after replacement of bone flap – perfect surgical/cosmetically results A/P view

Two patients were complaining because of unpleasant abdominal pressure sensation. In seven cases of bilateral craniectomy, calvarial bones were preserved on both sides each.

CONCLUSION

When there is a high intracranial pressure and is not

linked to evacuable mass lesions, such as in patients with massive bilateral brain swelling or unilateral massive brain swelling, medical treatment in such cases is frequently ineffective in controlling high intracranial pressure. Decompression craniotomy should be seen as a last resort therapeutic option. Routine decompression craniotomy should not be recommended for all patients with brain swelling. Early decompressive craniotomy is a therapeutic option in the management of these patients.

The size of craniectomy is of critical importance. Small craniectomies risk brain herniation with venous infarction and increased edema at the bone margins.

Replacement of the bone removed at craniotomy, a fresh skull autograft, is superior to all alternative forms of cranioplasty.[2,3,4,7,12,14,15] Recently, custom alloplastic implants prefabricated from computed tomography data have made alloplastic reconstruction of these large defects more precise and less time consuming. However, the risks of complications related to a large foreign body remain. For these reasons, returning the bone removed during decompressive craniectomy to the defects at a later date is an attractive reconstructive alternative.[1,5,13,14] While cranioplasty with a frozen or freeze-dried craniectomy graft results in an initial perfect reconstruction, it is subject to a high rate of graft resorption after replacement. In Hauptli and Segantini's[8] series of 143 craniectomy grafts undergoing cryogenic preservation, 86 (60%) had osteolysis significant enough to produce instability or unsatisfactory cosmetic results and 23 patients (16%) required surgical revision. In contrast, Hauptli and Segantini reported that only 3 of 42 (7%) of subcutaneous preserved grafts required revision cranioplasty. Three of our thin patients experience some discomfort from the stored graft in abdominal pouch. Bone flap was stored between the fat and muscle tissue. Autogenic bone flap is alive, not expensive, and perfectly fit with the size of the defect. Brain protection and cosmetic aspects are the major indications of cranioplasty.

We think that storage of the patients own bone flap in the abdominal pocket is a safe, easy, cheap, sterile, histocompatible, and better cosmetic results. When replacement the bone removed at craniotomy, a fresh skull autograft is superior to all alternative forms of cranioplasty such as methylmetacrylate or some metals like tantalum. When compared to the use of synthetic cranioplasty materials, a personal bone flap has very low percentage of inflammatory complications. This procedure is standardized in our University Neurosurgical Clinic of Kosova (post war country) from 1999 and we kindly prefer this procedure to other centers.

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