

Timing of Cranioplasty after Decompressive Craniectomy for Ischemic or Hemorrhagic Stroke

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Introduction

The DECIMAL, DESTINY, and HAMLET trials have shown that decompressive craniectomy to treat malignant cerebral edema after stroke increases survival. The appropriate timing of cranioplasty after craniectomy for stroke is not known. We aimed to determine the effect of early cranioplasty (within 10 weeks) on the rate of complications.

Methods

Between 2001 and 2010 we identified 74 patients that underwent cranioplasty after decompressive craniectomy for malignant cerebral edema from ischemic or hemorrhagic stroke. Patients were separated into early (within 10 weeks of craniectomy) and late cohorts based on median time to cranioplasty. We compared rates of infection, hydrocephalus, epidural hematoma, and bone resorption between the two cohorts. Baseline characteristics are displayed in Table 1.

Table 1. Baseline characteristics of the early (< 10 weeks between craniectomy and cranioplasty) and late cohorts (≥ 10 weeks).

Characteristic	Early cranioplasty (n=37)	Late cranioplasty (n=37)	p-value
Mean age in years (±SD)	44.7 (19.8)	50.3 (12.9)	0.1510
Male patients (%)	19 (51.4)	18 (48.6)	0.8694
Mean weeks to cranioplasty (±SD)	5.0 (3.0)	22.1 (10.0)	
Reason for craniectomy			
Ischemic stroke (%)	12 (32.4)	17 (45.9)	0.2334
Subarachnoid hemorrhage (%)	10 (27.0)	7 (18.9)	0.4062
AVM Rupture (%)	10 (27.0)	3 (8.1)	0.0325
Intraparenchymal hemorrhage (%)	5 (13.5)	8 (21.6)	0.3594
Venous sinus thrombosis (%)	0 (0)	2 (5.4)	0.4932
Mean GOS at cranioplasty (±SD)	3.3 (0.8)	3.1 (0.5)	0.3982
Patients with GOS of 4 or 5 at cranioplasty (%)	12 (32.4)	6 (16.2)	0.1042
Cranioplasty type			
Autologous (%)	34 (91.9)	34 (91.9)	1
Synthetic (%)	3 (8.1)	3 (8.1)	
Presence of CSF shunt (%)	6 (16.2)	4 (10.8)	0.4976
Use of subgaleal surgical drain (%)	19 (51.3)	26 (70.2)	0.0954
Mean operative time in minutes (±SD)	102 (45)	92 (32)	0.2989
Mean followup in months (±SD)	13.5 (18.4)	13.3 (19.1)	0.9271
Patients living at home at cranioplasty (%)	19 (51.3)	20 (54.1)	0.8231

GOS = Glasgow Outcome Score (1=dead, 2=vegetative state, 3= dependent & disabled, 4=independent, 5=return to work)
p-values calculated with chi-squared test for categorical variables except when expected value is less than 5, then Fisher's exact test was used.
p-values calculated with unpaired two-tailed student t-test.

Table 2. Complications reported in early (<10 weeks) and late (≥ 10 weeks) cranioplasty cohorts.

Complication	Early cranioplasty (n=37)	Late cranioplasty (n=37)	p-value	All patients (n=74)
Hematoma (%)	1 (2.7)	2 (5.4)	0.5637	3 (4.1)
Infection (%)	5 (13.5)	3 (8.1)	0.7106	8 (10.8)
Hydrocephalus (%)	1 (2.7)	0 (0)	1.0	1 (1.4)
Bone graft resorption (%)	1 (2.7)	1 (2.7)	1.0	2 (2.7)
Total	8 (21.6)	6 (16.2)	0.5541	14 (18.9)

p-values calculated with chi-squared test except when expected value is less than 5, then Fisher's exact test was used.

Table 3: Logistic regression analysis results for infection and complications (n=74).

Variable	Values	Infection (n=8, 10.8%)		Any complication (n=14, 18.9%)	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Age	< 65 years	1.0		1.0	
	≥ 65 years	0*	0.9982	0*	0.9975
Time to cranioplasty	< 10 weeks	1.0		1.0	
	≥ 10 weeks	0.55 (0.10, 3.09)	0.4990	0.90 (0.26, 3.13)	0.8799
Sex	Male	1.0		1.0	
	Female	3.13 (0.48, 20.5)	0.2326	0.46 (0.12, 1.75)	0.2572
Type of cranioplasty	Autologous	1.0		1.0	
	Synthetic	1.21 (0.09, 17.2)	0.8866	0.53 (0.05, 6.20)	0.6166
Presence of VP Shunt	No	1.0		1.0	
	Yes	7.81 (1.47, 41.6)	0.0160	8.96 (1.84, 43.6)	0.0067
Use of surgical drain	Yes	1.0		1.0	
	No	0.52 (0.10, 2.87)	0.4548	0.62 (0.17, 2.19)	0.4556

* No patients 65 years or older (n=9) had infection, hematoma, hydrocephalus, or bone resorption as a complication

NA = Not applicable

Results

There were 37 early and 37 late cranioplasty patients. There were no significant differences in age, sex, reason for decompression (ischemic or hemorrhage stroke), presence of VP shunt, or use of surgical drains between the cohorts.

Complication rates between the early and late cohorts showed no significant difference (21.6% early; 16.2% late, p=0.5930). The early cohort had higher rates of infection (13.5% early; 8.1% late, p=1) and the late cohort had higher rates of epidural hematoma (2.7% early; 5.4% late, p=0.7106), though neither difference was statistically significant. The rates of hydrocephalus and bone graft resorption were similar between the cohorts. Complications are summarized in Table 2.

Multivariate logistic regression analysis was used to identify predictors of complications revealed a higher risk in patients undergoing cranioplasty in the presence of a VP shunt (OR 8.96, 95% CI 1.84 – 43.6, p=0.0067). Age, time to cranioplasty, sex, type of cranioplasty (autologous vs. synthetic), and use of surgical drains were not predictive of complications (Table 3).

Conclusions

There is a trend toward higher complication rates, including infection, in performing cranioplasty within 10 weeks of craniectomy for stroke. Patients with VP shunts are at increased risk for post-cranioplasty complications.

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