Advanced Cranial Reconstruction Utilizing Intracranial Free Flaps and Cranial Bone Grafts: An Algorithmic Approach Developed From the Modern Battlefield

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Background: The objective of this study is to report outcomes after initiation of an algorithmic approach (Bethesda protocol) utilizing intracranial free flaps, cranial bone autografts, and dermal/fat grafts to treat warfare related cranial frontal-facial defects after war-related decompressive craniectomy.

Methods: A retrospective review of personnel undergoing complex cranial defect reconstruction that required free flap interpositions for dead space obliteration or cranial bone grafting, dermal/fat grafting for orbital defects was performed over a 52-month period.

Results: From March 2003 to July 2011, 13 patients were identified who underwent complex craniofacial defect reconstruction. All patients were male (average age 25 years). Average follow up was 3.6 years. Glasgow Coma Score (GCS) was 7 initially and 9 on arrival to the continental United States. Average evacuation time was 4.2 days. Forty-six percent of injuries were blast injuries. Nine patients (69%) underwent hemi-craniectomies and four patients (31%) bi-frontal craniectomies. Two patients required free flaps and four patients required free flaps and cranial bone grafts for skull base reconstruction. Five patients required cranial bone grafts and two patients required cranial bone grafts with dermal fat grafts for reconstruction. All patients were complication free at conclusion of the study. Initial free flap success rate was 85% (6/7 flaps). Successful frontal bar/free flap reconstruction was present in 100% and secondary cranioplasty rate was 77% (alloplast implant n=6, cranial bone grafts n=4). Morbidity included revision free flap (n=1), seizure disorder (n=4), and contour abnormalities (n=7). Mode Glasgow Outcome Score was 3 (range 3 – 4).
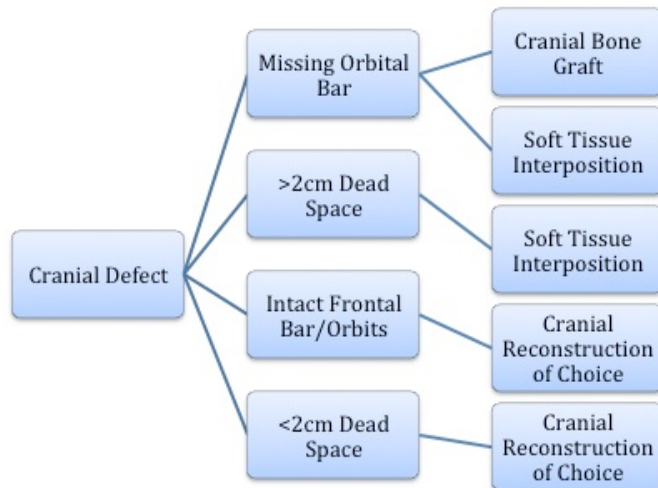

Figure 1. Our algorithm highlighting orbital reconstruction and dead space obliteration and final cranial reconstruction using either alloplast or autograft is acceptable.

Conclusions: Decompressive craniectomy defects associated with orbital, sinus, and skull base defects can be successfully reconstructed using an algorithmic approach with low morbidity and high secondary cranioplasty retention rates.

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