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Case Presentation

Custom Fabrication of a 3-Dimensionally Printed Helmet for Improved Socialization and Subjective Self-Assessment in a Case of Acquired Cranial Defect: A Case Presentation

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Abstract

Traumatic injury and subsequent residual cosmetic deformity are subject of intense scrutiny for their effects on objective health measures assessing patient morbidity and mortality. Although these remain principal concerns of all members of the treatment team, of less immediate yet lasting importance to the patient are the social costs of such disfigurement. Subjective feelings of unease and embarrassment can hinder social reintegration and encourage deteriorating psychosocial health. The following presents a case of one such individual who sustained traumatic brain injury and associated pneumocephalus and osteomyelitis requiring surgical debridement with bifrontal craniectomy and lobotomy. Postoperative management was cosmetically improved by the application of a custom-fabricated, 3-dimensionally printed helmet used in place of generic over-the-counter hardware, and the associated improvement reported in patient satisfaction is reported.

Level of Evidence: To be determined.

Introduction

Rehabilitation of the posttraumatic patient is a multifaceted process requiring intensive intervention by members of a diverse treatment team. Although drawing from different specialties, an important goal of all of these is to rehabilitate the patient to once again feel comfortable with social engagement and societal reintegration, fostering inclusion among friends and family as well as in the community at large. The variable nature of trauma and its recovery present significant hindrances to the reintegration process, due in large part to a combination of residual functional limitations and cosmetic deformity.

A recent systematic review of patients with traumatic brain injury (TBI) demonstrated consistent depreciation in subjective assessments of self-esteem by a majority of study participants [1]. This perhaps intuitive conclusion is contrasted heavily when compared to the body of literature suggesting that rehabilitation efforts after TBI tend to overlook the impact on the sense of self, focusing instead on functional impairment and

psychological distress [2]. In a study by Ponsford et al, patients who sustained TBI had significantly lower mean scores of global self-esteem and self-concept compared to controls. Survivors also score poorly on a range of self-dimensions including social, family, academic, work, and personal self-conception while reporting higher mean levels of depression and anxiety and an elevated incidence of suicidality relative to that of the general population [3,4]. These statistics therefore necessitate interventions from the treating clinician, when at all possible, to attempt to improve the emotional and psychosocial well-being as part of harm reduction strategies targeting morbidity and mortality in this patient population.

Case Presentation

A 38-year-old man of Middle Eastern origin sustained TBI in 2011 secondary to a motor vehicle accident, resulting in cerebrospinal fluid leak requiring placement of a ventriculoperitoneal shunt for the treatment of intracranial hypertension. Recovery was complicated by



Figure 1. A 38-year-old Middle Eastern man after bifrontal craniectomy and lobotomy. (A) Anterior and (B) lateral views of patient before the fitting of a custom-fabricated 3D-printed external helmet. (C) View of the device once properly fitted to the patient. (D) Patient displaying ease of wearing religious headdress on top of prosthetic device, formerly unachievable with use of off-the-shelf helmet.

the development of encephalitis with pneumocephalus status post shunt that progressed to a disseminated osteomyelitis of the frontal bone bilaterally. The infection required emergent surgical debridement with bifrontal craniectomy and lobotomy, resulting in substantial alterations in cognition, memory, and behavior due to the radical nature of the intervention (Figure 1A and 1B).

At this time, the patient was referred to our facility for quality-of-life measures, of which various surgical and nonsurgical alternatives were discussed. The patient was currently making use of an off-the-shelf

helmet that was bulky and cumbersome while making him feel self-conscious about his deformity and uncomfortable around others. In addition, the patient was unable to wear the traditional Arab headdress or keffiyeh common to his people, causing anxiety and self-isolation from religious ceremonies as well as from his own children. Although eager to resolve the issues secondary to his deformity, the patient and family were uncomfortable with attempting additional surgical interventions, instead opting for a nonsurgical approach. This necessitated the fabrication of a custom padded external helmet tailored to the patient's specifications.

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