

## Craniofacial Reconstruction Surgery for Complex Trauma

► At Penn Medicine, craniofacial surgeons collaborate with specialists in neurosurgery, oculoplastics, otorhinolaryngology and oral and maxillofacial surgery to perform reconstructive procedures that restore facial structure and neural integrity to patients with complex trauma to the face, cranium and brain. Access to the full spectrum of services required to address the complexity of craniofacial injury is generally limited to academic medical centers.

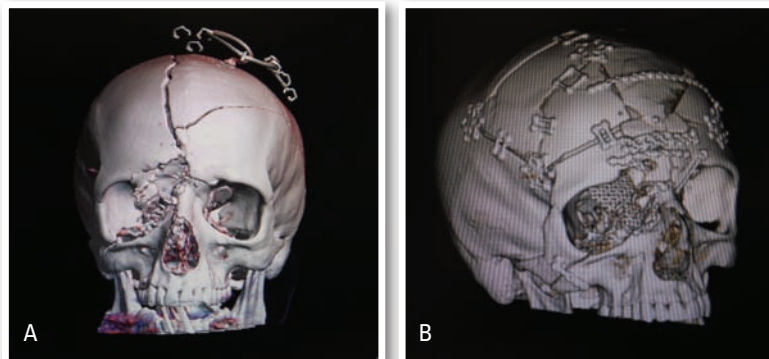
Craniofacial surgery, a subspecialty of plastic surgery, exemplifies the goal of reconstructive surgery: to restore form and function. Complex craniofacial trauma poses unique dilemmas, as the healing process of the intricate features of the face and skull can be capricious and unpredictable. Craniofacial surgeons must anticipate how bones and soft tissue will heal over time to mitigate potential scarring, wasting, soft tissue asymmetry and deformity. Avoiding these sequelae while sustaining sensory and nerve function in the muscles, bones, vasculature and skin of the face is an essential part of craniofacial reconstruction. Another imperative is that native structures be retained or salvaged when possible.

Craniofacial trauma often overlaps with injury to the CNS and brain, particularly when a wound penetrates the skull, orbits, nose, and sinuses. Thus, craniofacial surgeons at Penn work closely with neurosurgeons to address brain injury and to seal breaches in the dura mater and prevent ascending infection to the brain.

Trauma may impart large skull and bony facial defects. These may be reconstructed using autogenous (split-calvarial) bone and grafts from other native sources. Craniomaxillofacial fractures may also require metal or synthetic plates; meshes are used to restore absent orbital structures, and wires and screws are used to fuse or bond the cheek, temporal, and smaller facial bones. Ocular damage, and injury to the eyelids, canthus, nasolacrimal ducts and orbit of the eye may require the expertise of oculoplastic specialists.

Soft tissue wounds are decontaminated and debrided, and skin and soft tissue transfers are used, when necessary, to restore the symmetry and character of the face. Nerve defects may be repaired or grafted. Maxillofacial injuries, risk of airway obstruction, and dentoalveolar injuries with long-term potential for deformity are addressed at Penn by oral and maxillofacial surgeons and specialists in otorhinolaryngology.

Follow-up care for patients with craniofacial reconstruction has the aim of monitoring the success of the procedure and preventing possible late adverse effects (including infection, malunion, residual deformities and shifting bone or tissue), as well as reviewing the progress of rehabilitation.



► **Figure 1:** (A) Piercing wound to the skull with extensive fracturing/splitting of the frontal bone, cranium, right orbit and anterior skull base; (B) Same patient following reconstructive surgery involving plate and screw fixation, split cranial bone and synthetic mesh.

### CASE STUDY

Mrs. S, a 26-year-old woman, was brought to the Level II Trauma Center at Lancaster General Hospital after being shot in the forehead at close range with a small caliber handgun. The bullet created a large wound in the middle of her forehead and pierced the frontal bone, splitting the cranium into three pieces; the anterior cranial skull base and the inner orbit and canthus of the right eye were obliterated with surrounding bony structures fractured and depressed; the nasal bones were similarly affected (Figure 1A). Mrs. S was stabilized in the Trauma Bay, and a primary assessment of her airway, brain function and spine performed. She was then airlifted to the Level 1 Trauma Center at Penn Presbyterian Medical Center. There, an extraventricular drain was placed to measure intracranial pressure from the subdural/ subarachnoid space.

With evidence of sufficient brain function, craniofacial surgeon Phuong Nguyen, MD, and neurosurgeon James Schuster, MD, PhD, began to repair and reconstruct the injury, first performing a craniotomy to remove necrotic brain tissue, then reconstructing the dura and placing plates to realign the fractured cranium. The right orbit was then reconstructed with a combination of mesh, bone and wire, leaving the eye in place (Figure 1B). This was followed by cranialization and obliteration of the nasofrontal ducts (to prevent future infection) and using split cranial bone to reconstruct the anterior cranial base, thus separating the frontal and ethmoid sinus from the intracranial contents.

The surgeries were completed in seven hours. Mrs. S remained in the ICU for several weeks, after which she was placed in in-patient rehabilitation for six weeks. Thereafter, she returned home with visiting nursing care. Six months after her injury, she retains her native right eye (though is blind in it) and has some sensory defects. Her cognitive function has recovered nearly back to baseline. She lives at home with her mother, helps take care of her daughters, sees a psychotherapist, and is anticipating returning to work as a nurse soon.

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#### **Penn Medicine University City**

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### **Penn Oral and Maxillofacial Surgery**

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### **Scheie Eye Institute**

#### **Penn Presbyterian Medical Center**

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## FACULTY TEAM

At Penn Medicine, patients who suffer acute craniofacial injury are cared for by a multidisciplinary team comprised of trauma surgeons, craniofacial and plastic surgeons, neurosurgeons, otorhinolaryngologists, oral and maxillofacial surgeons, and specialists in oculoplastic surgery. The coordination and collaboration of these specialists, as well as their experience and the organizational infrastructure at Penn Medicine has contributed to a reputation for excellence in surgery and rehabilitative care.

### ► **Performing Reconstruction Surgery for Complex Craniofacial Trauma at Penn Medicine**

#### **Craniofacial and Plastic Surgery**

Phuong D. Nguyen, MD

*Assistant Professor of Surgery*

*Director of Adult Craniofacial Surgery*

*Penn Presbyterian Medical Center*

#### **Neurosurgery**

James M. Schuster, MD, PhD

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#### **Otorhinolaryngology-Head and Neck Surgery**

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*Assistant Professor of Clinical Otorhinolaryngology –*

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#### **Oral and Maxillofacial Surgery**

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*Chief, Oral and Maxillofacial Surgery*

*Penn Presbyterian Medical Center*

#### **Oculoplastic Surgery**

Cesar A. Briceno, MD,

*Assistant Professor of Ophthalmology*

Sonul Mehta, MD

*Assistant Professor of Ophthalmology*

#### **Traumatology, Surgical Critical Care & Emergency Surgery**

Patrick K. Kim, MD

*Trauma Program Director*

*Associate Professor of Clinical Surgery*