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# Novel Endoscopic Management of Penetrating Intracranial Trauma

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We report a unique case of minimally invasive endoscopic removal of a penetrating orbitocranial foreign body (POCFB), and present a review of the literature. A 12-year-old boy was impaled in the orbit with a gate latch. Neurosurgical consultation ascertained that removal via bifrontal craniotomy would necessitate extensive brain retraction and result in permanent anosmia. Attempting nasal endoscopic removal was deemed prudent, given this morbidity and a lack of brain parenchymal violation. The patient recovered without a cerebrospinal fluid leak or other neurologic sequelae. To date, craniotomy is the only reported management of POCFBs in the literature. We herein report the first nasal endoscopic removal of a POCFB.

**Key Words:** endoscopic surgery, eye injury, head injury, orbitocranial foreign body, penetrating injury.

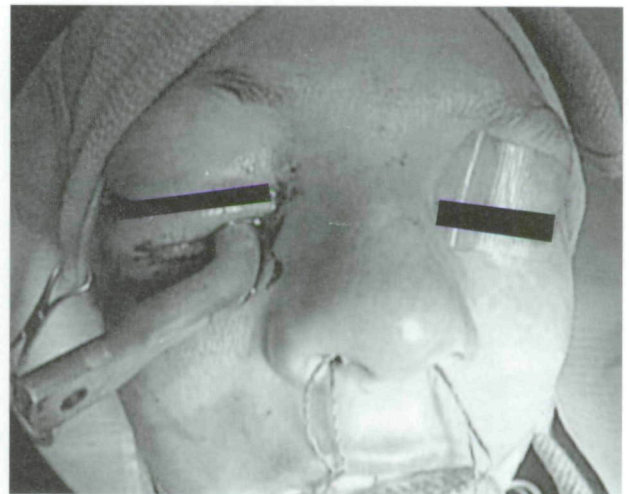
## INTRODUCTION

Penetrating orbitocranial foreign bodies (POCFBs) are striking injuries that can have a range of sequelae from severe debilitating ophthalmologic or neurologic damage to no significant permanent damage at all. The POCFB cases reported to date include chopstick, arrow, screwdriver, and nail injuries.<sup>1-5</sup> Until now, removal has invariably required frontal craniotomy. The potential complications of this neurosurgical approach include intracranial infection, hematoma, syndrome of inappropriate antidiuretic hormone, anosmia, and cerebrospinal fluid (CSF) leak. Therefore, this approach may not be ideal in all cases, and less invasive treatment options can be advantageous and preferable in selected cases. We herein report the first case of the nasal endoscopic removal of a POCFB and propose the indications for this approach. Institutional Review Board approval was obtained for this project.

## CASE REPORT

A 12-year-old boy was impaled in the orbit with a gate latch (Fig 1). Fortunately, he remained motionless until the paramedics detached the latch from the gate. In the emergency room, he was conscious and alert and oriented. There was no evidence of CSF leak, and ophthalmologic evaluation ruled out globe injury. Plain radiographs (Fig 2) and computed tomography (CT) imaging showed the latch sliding over the inferior orbital rim in a posterosuperomedial direction, displacing the globe laterally, piercing the lamina papyracea, and traversing the nasal cav-

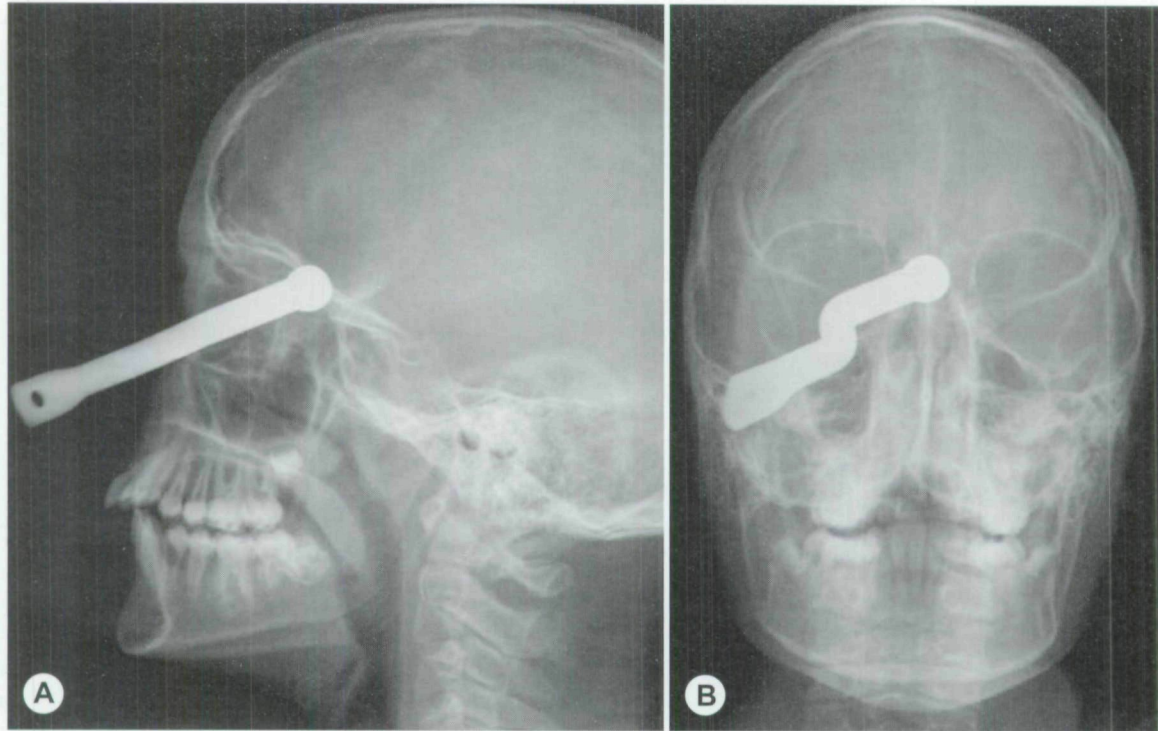
ity, ethmoid vault, and cribriform plate en route to the olfactory bulb. No evidence of brain penetration or contusion was noted. There was no intracranial hemorrhage noted on CT, and a CT angiogram ruled out vascular injury. Neurosurgical consultation ascertained that removal via bifrontal craniotomy would necessitate extensive brain retraction and result in permanent anosmia. Given this morbidity and no evidence of dural or brain parenchymal violation, attempting nasal endoscopic removal was deemed prudent. An endoscopic total ethmoidectomy was performed. The POCFB was successfully removed, and the dura was noted to be intact. A 1.5-cm anterior cranial base defect was repaired under direct endoscopic visualization with a composite osteomu-



**Fig 1.** Intraoperative image of point of entrance of gate latch in medial aspect of inferior eyelid.

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**Fig 2.** Radiographs of penetrating orbitocranial foreign body demonstrate trajectory and depth of penetration. **A)** Lateral. **B)** Frontal.

cosal graft from the ethmoid sinuses. The patient recovered without any neurologic sequelae, including no anosmia, intracranial infection, hematoma, CSF leak, or syndrome of inappropriate antidiuretic hormone. His vision was also completely intact.

Three years of follow-up have shown the patient to be free from sequelae, including no CSF leak or meningitis. Upon flexible fiberoptic nasoendoscopy, his anterior skull base is nicely healed without any evidence of skull base defects or encephaloceles.

#### DISCUSSION

The options for surgical management of orbitocranial foreign bodies penetrating the anterior cranial fossa include frontal craniotomy and endoscopic management. Frontal craniotomy would be indicated for cases in which there is intracranial vascular injury and hemorrhage. Evacuation of blood and control of hemorrhage would not be possible through an endoscopic approach. Furthermore, dural injury would increase the necessity of craniotomy. Although repair of dural injury is possible through an endoscopic approach, this requires a high level of expertise, and craniotomy allows a more definitive repair. Therefore, if dural breach or vascular involvement is suspected, an open transcranial approach would provide a safer, more conservative option for removal of the object, addressing any vascular injury, and repairing a dural laceration. Removal

of a foreign body penetrating the dura via a purely endoscopic approach may cause bleeding that would be difficult to manage and require a craniotomy.

The characteristics of this case that made endoscopic removal advantageous included a blunt object that was located medially within the orbit, traversed the sinonasal cavity, and did not cause globe injury, dural violation, CSF leak, or intracranial hemorrhage. Furthermore, the posterior point of penetration through the cribriform plate weighed against craniotomy. The main advantage of endoscopic removal was that the patient recovered without any deficit in his sense of smell, as would not have been the case with the extensive brain retraction necessary in the frontal craniotomy approach.

#### CONCLUSIONS

In deciding the prudent course of action in the treatment of POCFBs, they can be classified according to factors that are favorable to endoscopic removal (blunt object, penetration medial to the globe, lack of dural or brain parenchymal violation, and lack of intracranial hemorrhage) and those that are unfavorable to frontal craniotomy (posterior penetration through the cribriform plate). Nasal endoscopic removal of POCFBs is a valid technique and is preferable in select cases. Although this article details a utility of endoscopic skull base surgery, it should be judiciously used for management

of orbitocranial foreign bodies. We herein present the first case of successful endoscopic removal of

a POCFB and extend the application of endoscopic sinonasal surgery.

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