

Complex Anterior Skullbase Fracture Caused by a Bottle Cap: A Case Report and Review of the Literature

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We report a case of foreign body presence in the ethmoid sinus cavity with anterior skull base fracture and visual loss. A 42-year-old male had an uncertain history of trauma and a penetrating wound near the left medial canthus. Computed tomography imaging showed a 3.0-cm bottle cap penetrating into the anterior skull base. He underwent foreign body removal, canalicular repair, ethmoidectomy, and cerebrospinal fluid leakage repair using packing material. Six months after the initial surgery, a second-stage operation for blow-out fracture repair was performed. At the 18-month postoperative follow-up from the initial surgery, the patient had no complaints except anosmia. This is a very rare case of a large, blunt, foreign body penetrating into the anterior skull base without long-term complications after successful removal and skull base repair. Simultaneous repair of cerebrospinal fluid leakage, management of canaliculi injury, and traumatic optic nerve neuropathy should be considered in such cases.

KEY WORDS: Skull base · Bottle cap · Foreign body.

INTRODUCTION

Penetrating injuries of the paranasal sinuses and adjacent structures including the orbit and skull base are rare, especially when the foreign body has a wide base. Due to the small dimensions of the paranasal sinuses, a large foreign body within the ethmoid sinus is not common. However, foreign bodies including glass, air gun projectiles, metal splinters, and plastic chair glides have been reported.¹⁻⁵⁾

Previous reports of paranasal sinus foreign bodies have used two main approaches to remove the foreign body: endonasal endoscopic and external or combined approaches.^{3,6)} There may also be the need to repair concomitant cerebrospinal fluid (CSF) leakage, which is challenging.

In this article, we describe an unusual case of penetration of the ethmoid sinus and anterior skullbase by a blunt

object with a wide base. Additionally, we discuss appropriate management of large foreign bodies within the ethmoid sinus that involve the orbit and adjacent anterior skull base. Only a few cases of ethmoid sinus foreign bodies resulting in CSF leakage have been documented in the English medical literature. Here, we document a case with long-term follow up data and excellent cosmetic and functional outcomes.

CASE REPORT

A 42-year-old male presented with an open wound over the left medial canthus and upper eyelid (Fig. 1A). He was transported in a drunken state to the emergency room by a bystander, and was found to have a drowsy mental status. He could not remember how the wound was made and complained of a dull pain over the left periorbital area. Phys-

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ical examination showed that vital signs were stable, and there was no evidence of neurologic deficit. Ophthalmologic examination showed impaired left visual acuity (hand motion recognition only) with dilatation of the pupil, and canalicular injury of the left eye (Fig. 1B). There was a limitation in evaluation of extraocular movement due to the drunken state of the patient. Endoscopic intranasal examination was limited due to intranasal swelling and a lodged blood clot. Computed tomography scans showed a wide-based foreign body that looked like a bottle cap in the ethmoid sinus cavity, measuring 3.0 cm at widest diameter. The anterior skull base including the crista galli and cribriform plate were fractured and deviated to the right side (Fig. 1C and D). There was no evident injury of the optic canal.

The patient underwent extranasal exploration and removal of the foreign body through the original wound under general anesthesia. We were able to remove the foreign body via the external wound safely. After successful removal of the foreign body via external approach, we were then able to observe fractured skullbase bones, including the crista galli. Under endoscopic view, most fractured bones were removed and a definite CSF leak was observed. The length of the dura tear was measured 1.5 cm in length. After meticulous irrigation and repositioning of the remnant skullbase bones, dura repair was performed using fibrin-coated collagen fleece (TachoComb; Nycomed Co, Denmark). Then, canalicular laceration and medial canthal ligament repair were performed simultaneously.

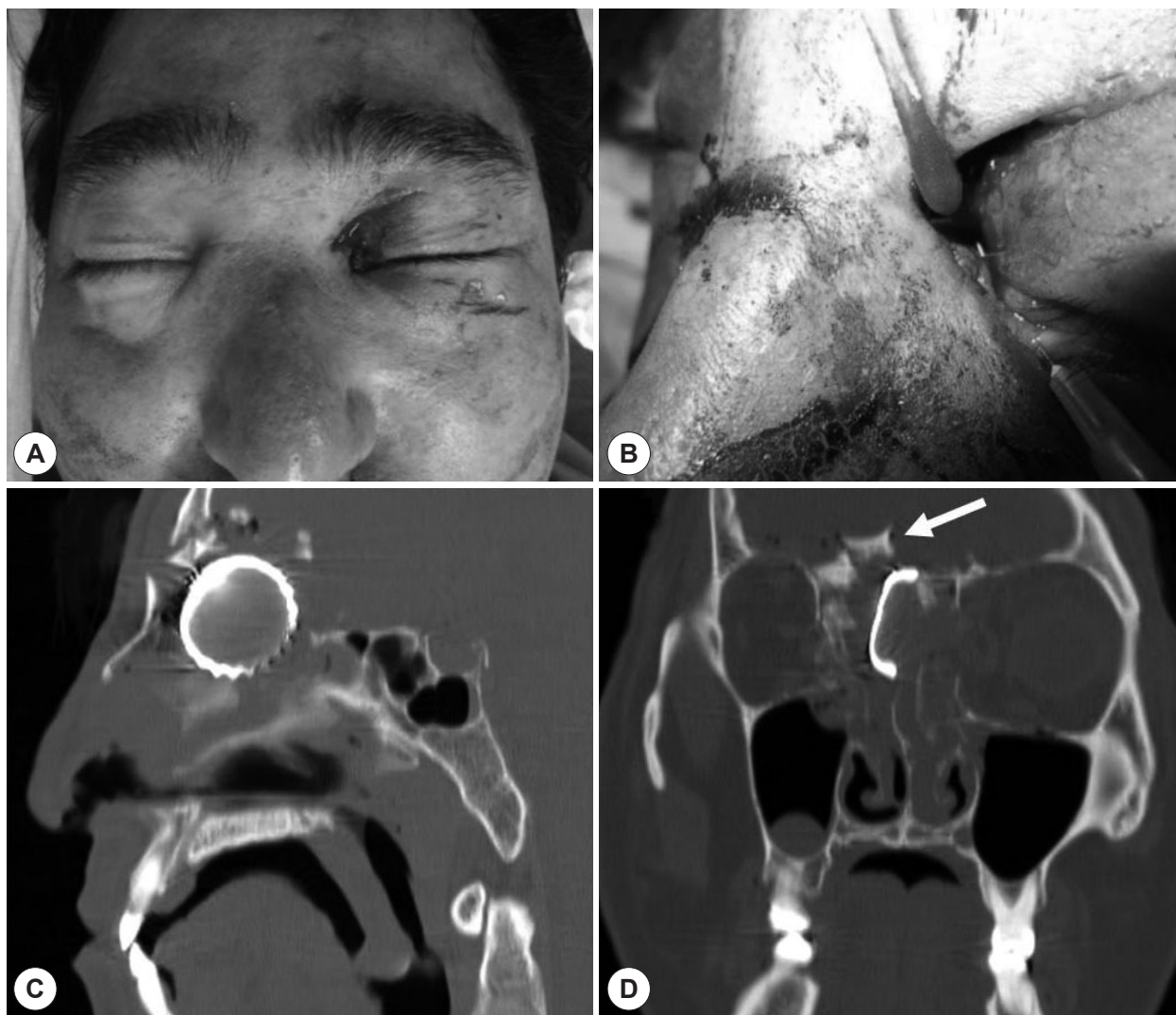


Fig. 1. A: Entry wound over the left medial canthus. B: Needle probing showing canalicular injury and medial canthal laceration. C: Sagittal computed tomography (CT) scan showing a bottle cap in the anterior ethmoid sinus with anterior skull base disruption. D: Coronal CT scan showing bilateral medial orbital wall fracture with displacement of the crista galli and cribriform plate (white arrow).

Perioperative systemic administration of methylprednisolone 1,000 mg per day was maintained for 3 days followed by a tapering dose of prednisolone for a further 10 days. Lumbar drainage of CSF was maintained for 5 days with absolute bed rest. Ceftizoxime, levofloxacin, and metronidazole were applied as perioperative antibiotics for 5 days. There was gradual visual improvement of the left eye from the third postoperative day. The patient was discharged 14 days postoperatively without CSF rhinorrhea, visual impairment, or neurologic deficit except for olfactory loss.

Six months after the initial surgery, second stage blow-out fracture repair of the infero-medial wall with a polyethylene implant (Medpor; Stryker Co, Georgia, USA) was

performed for enophthalmos correction. At the 18-month postoperative follow-up from the initial surgery, the patient was doing well without neurologic or visual deficit and did not complain of any disfigurement (Fig. 2A). However, the patient still suffered from anosmia. The Cross Cultural Smell Identification Test (CC-SIT) score was 3/12. Endoscopic examination and computed tomography scans showed a well-repaired anterior skull base without sign of CSF leakage or displacement of the orbit wall (Fig. 2B, C and D).

DISCUSSION

A foreign body within the ethmoid sinus from penetrat-

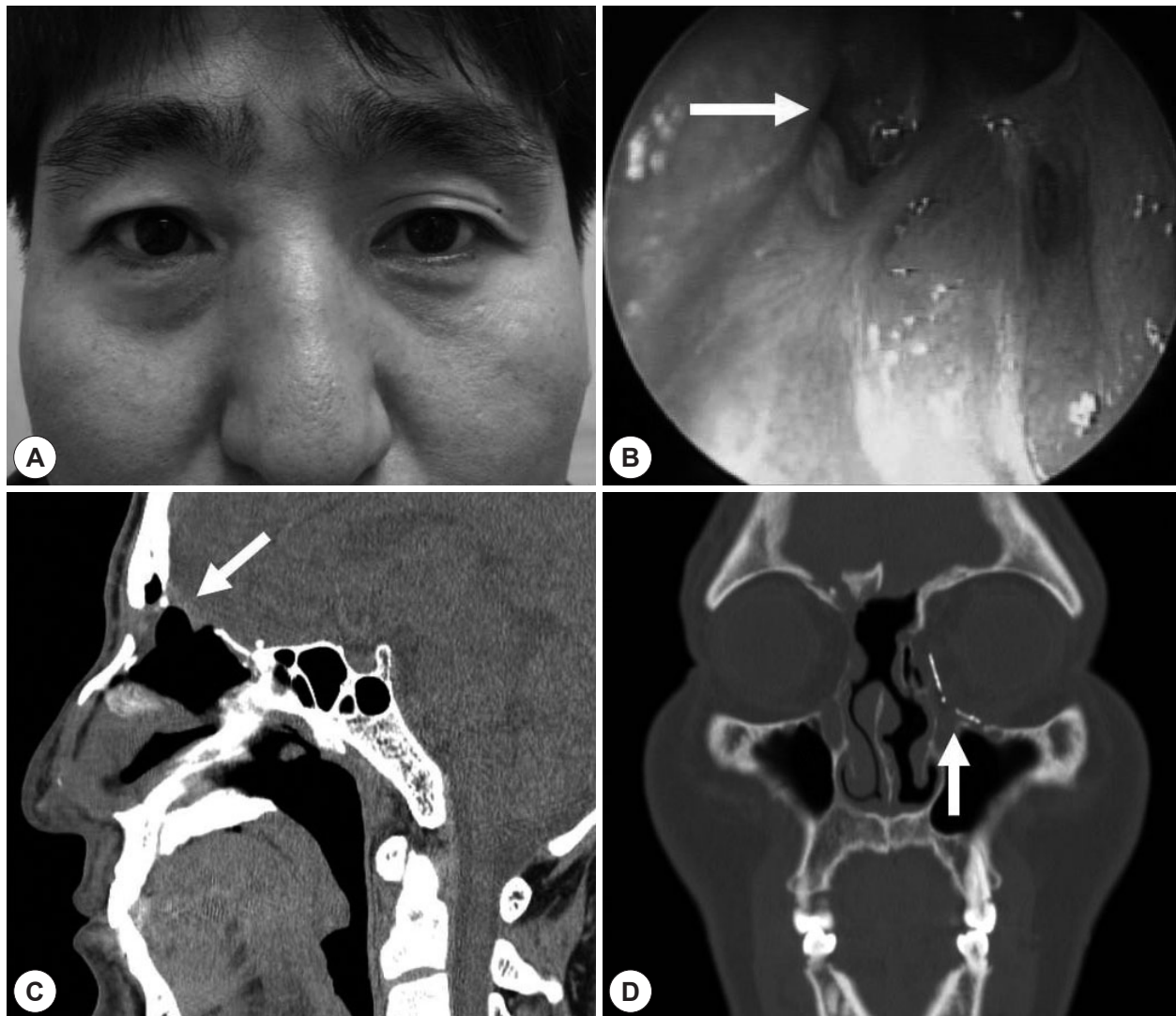


Fig. 2. A: Postoperative 18-month facial photo showing a well healed wound without orbital displacement. B: Endoscopic exam showing repaired anterior skull base without CSF leakage (white arrow). Endoscopic follow-up of the skull base was possible at the outpatient clinic because complete ethmoidectomy was performed simultaneously at the initial surgery. C: Sagittal computed tomography scan showing a well delineated anterior skull base without herniation (white arrow). D: Coronal CT scan showing the orbit wall reconstructed with medpor implant material (white arrow).

Table 1. Published cases of anterior skull base injuries with ethmoid and intradural foreign bodies

Number	Year	Author	Sex/ Age	Size (cm)	Shape	Type of foreign body	Entry point	Route of removal	CSF rhinorrhea			Repair method	Visual impairment	Postoperative complications
									Preoperative	Intraoperative	Postoperative			
1	1992	Fallon et al.	F/2	7.0	Sharp	Wooden stick	Endonasal	Craniotomy	None	Yes	Yes	Packing	None	None
2	1995	Asano et al.	NS	NS	Sharp	Metallic fragment	Transorbital	External	None	Yes	Yes	NS	Permanent [†]	Visual loss
3	2000	Sharif et al.	M/44	14	Sharp	Ballpoint pen	Endonasal	Craniotomy	Yes	Yes	Yes	NS	None	None
4	2004	Brinson et al.	M/15	0.5	Round	Airgun projectile	Endonasal	Endonasal	None	Yes	Yes	Septal mucosal graft	None	None
5	2004	Dodson et al.	M/34	6.0	Sharp	Metallic pen	Endonasal	Endonasal	None	Yes	Yes	Bone and mucosal graft	None	None
6	2006	Isao et al.	M/45	2.5	Blunt	Plastic chair glide	Transorbital	Combined*	None	None**	None	Not performed	Temporary	CSF leakage
7	2006	Cetinkaya et al.	F/4	25	Sharp	Pencil	Endonasal	Endonasal	None	Yes	Yes	Packing, lumbar drain	None	None
8	2007	Thomas et al.	M/41	0.3	Round	Airgun projectile	Endonasal	Endonasal	None	Yes	Yes	Turbinate mucosal graft	None	None

*: p < Combined endonasal endoscopic and external approach, **: p < Delayed CSF leakage was observed 3 days after the operation, †: Permanent visual impairment due to direct optic canal injury. CSF: cerebrospinal fluid, NS: not stated

ing trauma with damage of the adjacent anterior skull base is an extremely rare event. Foreign bodies within nasal sinuses are rare, and mostly involve the maxillary sinus. Only a few cases of an ethmoid foreign body have been documented (Table 1).¹⁾³⁾⁵⁾⁷⁻¹¹⁾ This is the first report of successful treatment of a large, blunt, foreign body in the ethmoid cavity with combined eyeball and dural injury with a minimally invasive procedure without postoperative complications. In previous reports of patients with broad anterior skull base injuries, CSF leaks were repaired by nasal turbinate mucosal or bony grafting (Table 1, patients 2, 6, and 7). However, in the present case, despite the extensive skull base fracture, the injured dura healed completely without other donor site morbidity. Furthermore, the present case is distinctive because of the position in which the foreign body came to rest, in addition to its blunt shape and large dimensions within the sinus cavity, which resulted in penetration of the skullbase.

In the present case, a fine-cut computed tomography scan was useful for diagnosis and played an important role in proper evaluation of the extent and exact nature of the foreign body. However, if the foreign body or fracture line had been adjacent to cerebral vessels, evaluation of cerebral vessels using angiography or CT or MR angiography would have been mandatory.

For foreign bodies in the nasal sinus, early intervention is recommended because of the potential for serious infectious complications, including chronic rhinosinusitis, cutaneous fistula, and meningitis.¹⁾⁶⁾ Moreover, as in this case, fracture of the anterior skull base, canalicular injury, and impaired visual acuity are reasons for urgent exploration and foreign body removal.

There are two suggested approaches for removal of a foreign body within the ethmoid and skull base: endonasal endoscopic and external approaches.³⁾ Furthermore, height and shape of the skull base should be considered preoperatively. In the case of blunt foreign bodies with an external entry point in the periorbital area, foreign bodies have been removed from the external entry wound or using a combined approach (Table 1, patients 1 and 3). In contrast, sharp and long foreign bodies with an endonasal entry point have been removed endonasally or by craniotomy with dural repair (Table 1, patients 2, 4, 5, 6, 7, and 8). The external approach may allow better assessment of the extent of the injury by facilitating examination with a microscope or endoscope. Postoperative endoscopic follow-up for CSF leak-

age is also possible when complete ethmoidectomy is performed simultaneously (Fig. 2B). External approach has the disadvantage of creating a scar. However, in our case, we used an external approach due to the large size of the foreign body that could not be removed via the nostril, and also because there was a large entry wound already. Fortunately, a good cosmetic outcome was obtained postoperatively (Fig. 2A).

Traumatic skull base injuries can be divided into iatrogenic injuries from surgery and accidental traumatic injuries.¹²⁾ While most traumatic CSF leaks will stop with conservative treatment, patients with a persistent leak are considered to be at risk of meningitis, and surgical exploration is advocated.¹³⁾ Furthermore, traumatic CSF leaks have been reported to occur in 2.6% of all closed head traumas and are more frequent in skull base fracture cases.¹²⁾ Even if there is no sign of definite CSF leak intraoperatively after foreign body removal, careful endoscopic examination of the exposed dura is important because there is a reported case of delayed onset CSF leakage after foreign body removal.³⁾ The majority of accidental traumatic CSF leaks can be managed conservatively with lumbar drain insertion and bed rest.¹²⁾ We considered performing a staged operation for the CSF leak using a pericranial flap or nasoseptal flap if there was consistent CSF leakage after primary repair with Tachocomb, because the foreign body was very large. However, the dura healed well with conservative surgical techniques.

Traumatic optic neuropathy (TON) is a traumatic injury of the optic nerve or secondary neuronal apoptosis of the optic nerve due to trauma.¹⁴⁾ Even though there is no definite injury of the optic canal wall based on preoperative radiologic evaluation, subsequent partial or total visual loss can occur.¹⁴⁾¹⁵⁾ After clinical diagnosis of TON, high-dose steroid therapy within 8 hours of injury is advocated as an initial treatment because of the neuroprotective mechanism of steroids.¹⁴⁾ In the present case, there was no significant optic canal wall injury or compression on computed tomography scans. However, the usefulness of imaging in TON remains debatable because there is no definite correlation between the severity of visual acuity loss, optic canal fracture, and prognosis for improvement of visual acuity.¹⁶⁾¹⁷⁾ Furthermore, in the present case, clinical features of TON, such as relative afferent pupillary defect, impaired color vision, and visual field defect could not be evaluated properly due to the drunken state of the patient.

Although there was little objective evidence for diagnosing TON, high-dose steroid therapy was used for this young and otherwise-healthy patient due to consideration of the risks and benefits of steroid therapy.

The rate of spontaneous visual improvement has been reported to be comparatively high in TON, and there is no conclusive data regarding the effects of steroids on visual improvement based on a review of the Cochrane database.¹⁸⁾ In the present case, high-dose methylprednisolone was used for 3 days perioperatively. Adverse effects including psychosis and pancreatitis have been reported after usage of the same dose of methylprednisolone in an optic neuritis treatment trial; however the incidence of adverse effect was relatively rare (two cases, 1.3%).¹⁹⁾ In this case, even though there was no definite injury of the optic canal wall in imaging evaluation, we decided to use high-dose steroids because we considered the potential benefits to the patient to be greater than the risks.

CONCLUSION

Ethmoid foreign bodies with adjacent skull base and orbit trauma are rare and usually non-fatal. Optic neuropathy and CSF leakage treatment should be performed simultaneously with careful examination of the fractured anterior skull base. Depending on the dimensions and shape of the foreign body in the ethmoid cavity, both endoscopic and external approaches should be considered for foreign body removal and CSF leak management. Use of prophylactic antibiotics to prevent meningitis and corticosteroids for traumatic optic neuropathy should be considered.

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