

# Versatility of the pedicled nasoseptal flap in the complicated basal skull fractures

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## ABSTRACT

With the advancement of transnasal endoscopic technique, endoscopic repair of basal skull fractures has considerably substituted former external approaches. The endoscopically feasible pedicled flap, named nasoseptal flap has been extending its range of application, since it was introduced for the reconstruction of the defect after resection of skull base tumors. We introduce two patients with complicated basal skull fractures at different sites who were successfully treated by the transnasal endoscopic approach using nasoseptal flap.

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## 1. Introduction

Fractures of the skull base have been reported to account for 3.5–24% of all skull fractures. It is known that the cerebrospinal fluid (CSF) leak occurs in 5–11% of the cases of skull base fractures and the severity of a head injury has no definite relations with the occurrence of the CSF leak [1]. Approximately 85% of immediate posttraumatic CSF rhinorrhea stops spontaneously within the 1st week and recurrent CSF leak after initial spontaneous cessation is observed in about 7% [2].

Meningitis is the most concerning complication in patients with CSF leak. The overall risk of meningitis is known to approach 30% in acute leak and 57% in delayed leak [3]. Once meningitis occurs in patients with traumatic CSF leak, the mortality rate can reach as high as 10%. Although the CSF leak can occur anywhere in the skull base from the posterior wall of the frontal sinus through the sphenoid sinus, the most frequent sites of leak are the cribriform plate and ethmoid bone [4]. Antibiotics turned out to be ineffective in preventing meningitis, thus reducing the CSF flow using conservative managements such as bed rest, elevation of the head of the bed, and lumbar drain insertion are the mainstay of the treatment for CSF leak [5]. In cases in which a CSF leak persists

despite these measures or brain herniation occurs, surgical repair can be indicated [1,4].

Numerous surgical techniques including intra- and extracranial surgeries have been employed in order to repair skull base fractures thus far [4]. Since the advent of transnasal endoscopic technique, morbidity from former surgeries such as scar, olfactory loss, and epilepsy particularly in pediatric patients has significantly decreased [6]. Nevertheless, there are still cumbersome cases such as large-size defects or complex fractures. Large defects of the skull base are frequently encountered after endoscopic resection of skull base tumors. Since the pedicled nasoseptal flap (NSF) was introduced, CSF leak from large skull base defects has been largely resolved. However, there have been limited studies on the use of NSF for traumatic basal skull fracture [7]. This paper aimed to determine the feasibility of the NSF in cases of the uncommon and troublesome basal skull fracture.

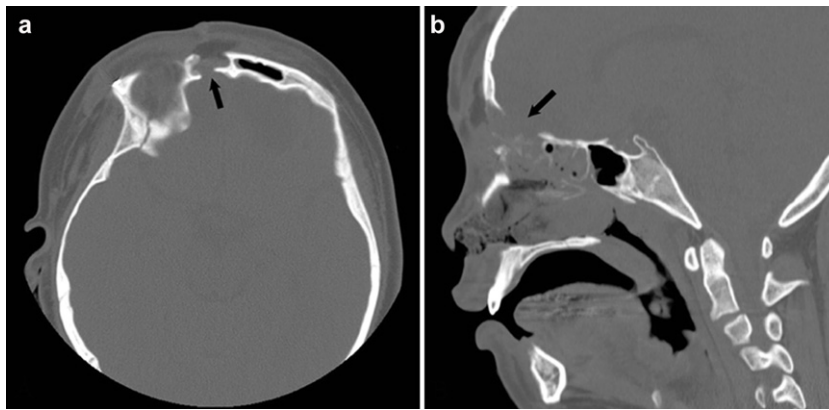
## 2. Case reports

### 2.1. Case 1

An 18-year-old man presented to the GNUH Emergency Department in March 2010 with a head injury after a motorcycle accident. Computed tomography (CT) identified multiple fractures in mandible, maxilla, zygoma, ethmoid and frontal bones, and intracranial hemorrhage (Fig. 1a and b). Open reduction, internal fixation of facial bone and skull, and primary closure of skin wounds were carried out. Since the CSF leak was suspected in the CT scan as well as in his symptoms, lumbar drainage was employed

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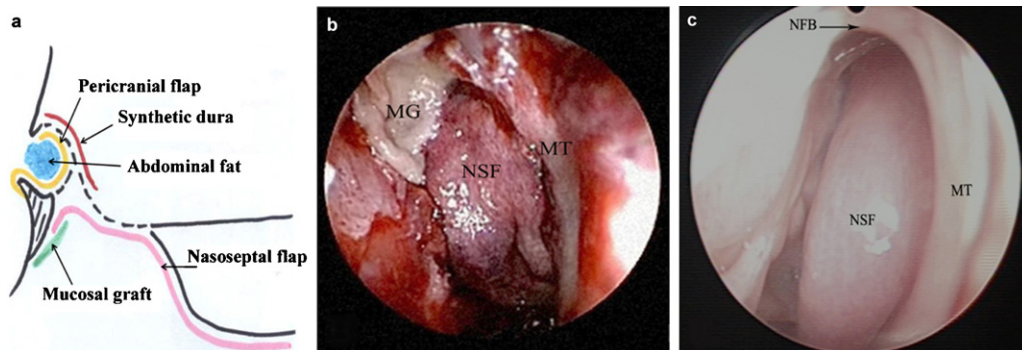
**Fig. 1.** Representative (a) axial and (b) sagittal computed tomography images of case 1. Fractures of anterior and posterior tables of the right frontal sinus and ethmoid roofs (black arrow) are demonstrated.

for 3 weeks. Despite prolonged placement of a lumbar drain with bed rest, CSF rhinorrhea persisted; thus, surgical repair of the CSF leak was performed by otorhinolaryngologists. Under general anesthesia, 0.1 mL of fluorescein dye (10 mg) diluted in 10 mL of the patient's own CSF was administered slowly into the intrathecal space; the NSF was then elevated and stored in the nasopharynx during surgery, as suggested by Kassam [8]. After right endoscopic anterior ethmoidectomy and frontal sinusotomy, CSF stained with greenish dye was detected. Then, the CSF leak site was identified via a transnasal and external approach in which pre-existing skin wounds were used. Bony defects were found on the lateral and posterior wall of the frontal sinus, and posterior wall defects were found to continue through the ethmoid roofs, which exceeded 2 cm in length. Fragmented bones of the anterior table of the frontal sinus and the remaining mucosa were removed. The surface of the remaining bones was drilled away in order to ensure complete removal of mucosa. Then, the pericranial flap was developed via existing skin wounds. Following placement of synthetic dura (Lyoplant, B. Braun Melsungen AG, Melsungen, Germany) in the lateral wall defect by inlay fashion, the pericranial flap was placed on the posterior and lateral walls, and the remaining frontal sinus was obliterated with abdominal fat (Fig. 2a). The size of the defect in the anterior wall was shorter than 1 cm in length; therefore, it was not repaired. Finally, after meticulous elimination of mucosa of the 3rd lamella and the lateral wall of the middle turbinate, the NSF was repositioned onto the skull base in order to cover the defect in the ethmoid roofs and support the obliterated frontal sinus. To ensure watertight coverage, a free mucosal graft, which was obtained from the right

uncinate mucosa, was positioned over the anterior boundaries of the NSF (Fig. 2b). Subsequently, Surgicel (Johnson & Johnson, North Yorkshire, UK) was placed around the edges to hold the flap in place, and DuraSeal (Confluent Surgical, Waltham, MA) was sprayed over the entire surface of the flap. Then, Gelfoam (Upjohn, Kalamazoo, MI, USA) and a tampon sponge (Merocel, Medtronic Xomed Surgical Products, Jacksonville, FL) were placed over the entire surface. Silastic splints were placed over the NSF donor site and left in place for 4 weeks and the lumbar drain was removed after 7 days postoperatively. He is now fully healed with no signs or symptoms of recurrent CSF leak or facial deformities and the NSF is well adapted on the leak sites (Fig. 2c).

## 2.2. Case 2

A 16-year-old man presented to the GNUH Emergency Department in May 2010 after sustaining multiple bone fractures of the head and lower limbs by a car accident. Multiple basal skull fractures, including right frontal bone and sinus walls, the roofs and lateral walls of both ethmoid sinuses and left sphenoid roof and walls were identified in CT scan (Fig. 3a and b). The left sphenoid sinus was predominant and had contact with an Onodi cell (sphenothmoidal air cell); thus, the CSF leak in the sphenoid sinus was deemed to come from multiple sites, including the defects of the Onodi cell. Following CSF drainage via a lumbar drain and close observation in the intensive care unit for several days, he underwent craniectomy with duroplasty due to severe brain edema. During the operation, anterior basal skull defects were repaired using bone cement. Thereafter, the otorhinolaryngology



**Fig. 2.** (a) A schematic illustration of the operative technique, (b) an endoscopic photograph of the operation sites taken during the operation and (c) an endoscopic picture taken at postoperative 12 months. The nasoseptal flap is well adapted on the wound and mucosal graft has been reabsorbed. MG, mucosal graft; NFB, nasofrontal beak; NSF, nasoseptal flap; MT, middle turbinate.

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