E-ISSN: 2708-1508
P-ISSN: 2708-1494
IJCRS 2025; 7(2): 97-100
www.casereportsofsurgery.com
Received: 05-06-2025
Accepted: 08-07-2025

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Cerebrospinal fluid fistula reconstruction at the skull base using free rectus abdominis flap: A case report

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DOI: https://www.doi.org/10.22271/27081494.2025.v7.i2b.209

Abstract
Introduction and Objective: Chronic cocaine use can lead to destructive lesions of the facial midline, which may extend to involve the skull base. In advanced stages, these lesions can cause cerebrospinal fluid leaks, intracranial infections and require complex reconstructive surgery. This article presents the case of a patient with skull base erosion due to prolonged cocaine use, successfully reconstructed with a free rectus abdominis muscle flap.
Case Report: A 36-year-old male with a history of daily intranasal cocaine use for fifteen years was referred with nasal septal perforation, destruction of the hard and soft palate and bony erosion at the clivus region of the skull base. The condition progressed to include leakage of cerebrospinal fluid, bacterial meningitis with associated acute hydrocephalus and pneumocephalus. A multidisciplinary team performed surgical debridement of the skull base using endoscopic techniques guided by a neuronavigation system followed by extended transfacial access. Reconstruction was achieved using a free rectus abdominis muscle flap harvested from the right abdomen and connected to the facial blood vessels on the same side.
Results: The procedure allowed complete coverage of the bony and dural defect. The muscle flap was anatomically adapted and securely fixed with sutures to surrounding bone structures to prevent postoperative displacement. The patient showed a favorable recovery in the early postoperative period, without recurrence of cerebrospinal fluid leakage or intracranial infection.
Conclusion: The free rectus abdominis muscle flap is a reliable and effective option for skull base reconstruction in patients with advanced cocaine-induced facial and cranial destruction. Its robust blood supply, elongated and narrow shape and versatility make it a suitable choice when local tissue flaps are not viable. Multidisciplinary collaboration is essential in the successful management of such complex surgical cases.

Keywords: Cocaine, skull base reconstruction, CIMDL, rectus abdominis flap

Introduction

Estimating the prevalence of cocaine use is challenging due to its illegal status. The 2021 World Drug Report by the UN estimates that approximately 19 million people (~0.4% of the global population aged 15-64) used cocaine in 2019 [1]. In Europe, the European Drug Report 2023 indicates that in 2022, 2.3% of people aged 14-34 used cocaine [2].

Chronic use is defined as cocaine consumption for at least six months, administered minimally four times per month, and is linked to numerous health problems (cardiovascular, neurological, hyperthermia), reducing patients' quality of life [3]. In the facial sphere, cocaine-induced midline destructive lesions (CIMDLs) [4] range from minor septal perforations to skull base involvement. *Nitroe et al.* [5] proposed a classification system for these lesions (Table 1).

A 2025 clinical consensus statement (CCS) addresses the definition, clinical evaluation, diagnosis, surgical management, and treatment of cocaine-related ENT complications [6].

In advanced cases - especially those involving the orbit, skull base or craniovertebral junction - a multidisciplinary approach is vital. Mild forms may be managed conservatively (nasal lavage, antibiotics, vaccination) but severe forms with cerebrospinal fluid (CSF) leakage or intracranial infection necessitate coordinated surgical reconstruction using vascularized flaps [6]. Abstinence for at least 12 months, confirmed by toxicology, is strongly recommended before definitive repair [6].

Until now, vascularized flaps described for skull base defects have included the pedicled frontal-flap and temporoparietal myofascial flap [7-8]. Herein, we report a case of skull base reconstruction using a free rectus abdominis flap [9].

Case Report

A 36-year-old male, with no drug allergies and a childhood appendectomy as the only relevant medical history, had been a chronic cocaine user (1 - 2 g daily over 15 years). In March 2025, he was referred for nasal deformity secondary to cocaine use. Further examination revealed septal perforation, nasal tip collapse, extensive hard and soft palate perforation and skull base erosion at the clivus (Image 1). Anatomically, the skull base is divided into anterior, middle, and posterior regions; the clivus spans from the sella turcica to vertebrae C1.

Due to the patient's inability to generate sufficient inspiratory capacity to sniff the drug, he placed it in the nasal vestibule while tilting his head backward, causing the substance to directly contact the clivus.

His condition deteriorated: continued use led to an active CSF fistula, meningoencephalitis, acute hydrocephalus and pneumocephalus. He required ICU admission, where he was initially extubated but then reintubated due to airway obstruction from high CSF secretion.

A multidisciplinary team (Neurosurgery, Maxillofacial, ENT and Plastic Surgery) decided on urgent surgical debridement and skull base reconstruction using a vascularized free flap.

Neuronavigation-guided endoscopic debridement safely removed necrotic tissue while protecting critical structures like carotid arteries and the brainstem. ENT identified multiple active CSF fistulas at the clivus (Image 2) and the brain at the middle and posterior skull base was exposed post-debridement (Image 3).

Simultaneously, Plastic Surgery harvested an 18×6 cm rectus abdominis flap from the right abdomen (Pedicle 7 cm, based on deep inferior epigastric vessels) - the right was chosen because a left-sided enteral feeding tube precluded left harvest (Images 4 and 5). Left epigastric vessels were also prepared as a backup if the pedicle was too short.

Maxillofacial Surgery performed an extended LeFort I osteotomy with sagittal segmentation and mandibular swing (Images 6 to 8) for direct access. The flap's pedicle was anastomosed to ipsilateral facial vessels; the flap was adapted to the middle-posterior skull base and secured with transosseous sutures to maxilla and piriform rim to prevent anterior displacement (Images 9 and 10).

Osteosynthesis was performed using Osteomed® 1.6 mm L-plates (Image 11). The abdominal donor site was closed with mesh reinforcement. To enhance flap integration, temporary nasal packing and a lumbar drain were placed to lower CSF pressure in the flap (Image 12).

Two weeks after surgery, the flap was fully integrated, and the patient was discharged with regular outpatient follow-up, reinforcing support to promote cocaine abstinence (Image 13).

Discussion

Chronic cocaine use can cause complex midline destructive lesions that, when advanced, involve the skull base and result in life-threatening intracranial complications. Management of such cases requires a multidisciplinary team, targeted antibiotic therapy, surgical debridement via endonasal or combined approaches, and use of vascularized flaps for durable reconstruction.

Reconstruction should not proceed without evidence of abstinence - ideally confirmed by 12 months of drug-free status (6) - due to risks of surgical failure and recurrence. In this case, despite ongoing cocaine use, surgery was justified as life-saving: without addressing the CSF leak, extubation was impossible.

The rectus abdominis flap (9) is a type III Mathes and Nahai flap with dual arterial supply (superior epigastric from internal thoracic artery and inferior epigastric from external iliac artery), making it highly versatile as both pedicled and free flap. Its long, narrow shape (up to 25 cm long and 6 cm wide) makes it excellent for complex skull base defects.

Compared with other free flaps (latissimus dorsi, gracilis, anterolateral, radial forearm), the rectus abdominis offers specific advantages: it's thin, highly malleable, easily contoured to irregular 3D spaces like skull base defects, and has a consistent pedicle for microvascular anastomosis. These properties make it a safe, effective and lasting reconstructive option following CSF fistula repair.

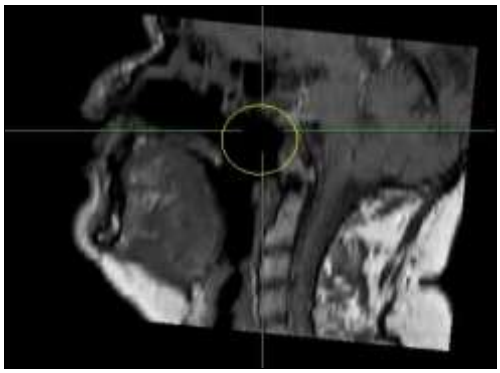

Image 1: Sagittal CT scan showing erosion of the skull base (clivus region encircled in yellow)

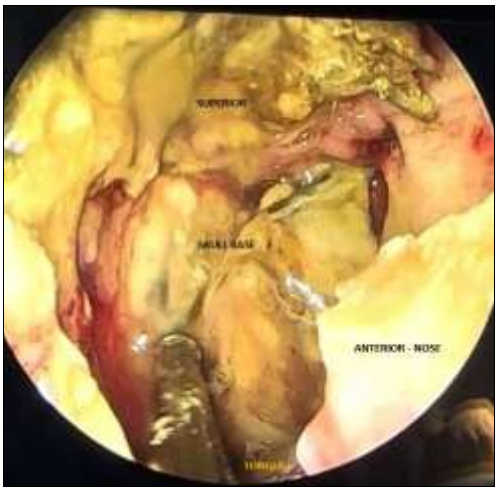

Image 2:. Endoscopic view of debris and erosion at the skull base.

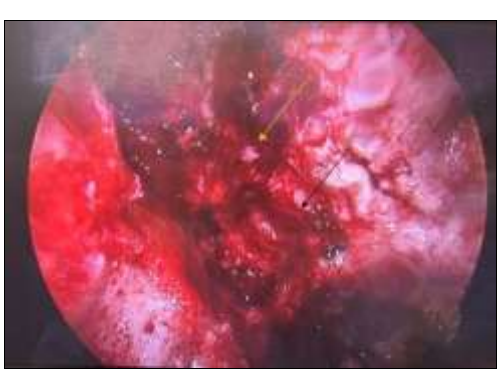

Image 3: Endoscopic view of the middle (yellow arrow) and posterior (black arrow) skull base after debridement.

Image 4 and 5: Dissected rectus abdominis flap (18 x 6 cm)

Image 6, 7 and 8: Extended maxillotomy approach (Le Fort I with sagittal segmentation) and mandibular swing technique to access skull base.

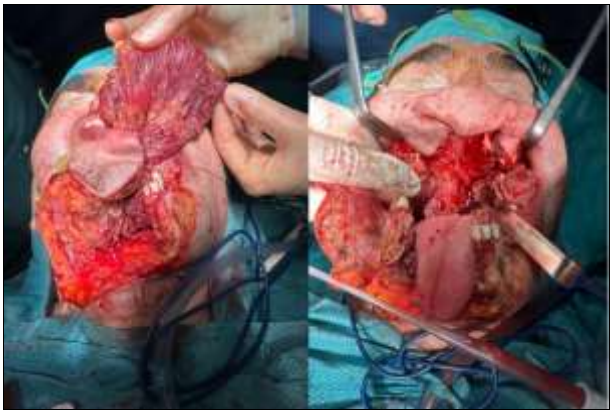

Image 9 and 10: Insetting of the flap.

Image 11: Osteosynthesis of the maxilla and mandible.

Image 12: Immediate postoperative final result.

Image 13: Two weeks postoperatively, with complete flap integration.

Table 1: Classification of Cocaine-Induced ENT Involvement According to Nitro *et al.*

Classification	Involvement
1	Nasal septum
2a	Grade 1 + inferolateral district (inferior turbinate and medial wall of the maxillary sinus)
2b	Grade 1 + palate
3	Grade 2 + ethmoid bone, middle or superior turbinate
4	Grade 3 + neurocranium (lamina papyracea, orbit or skull base)

Conclusion

The free rectus abdominis muscle flap provides a safe and versatile reconstructive option for complex skull base defects, especially when regional flaps are not viable. Careful planning, multidisciplinary coordination, patient follow-up and support including confirmation of abstinence are essential. The combination of medical, surgical and psychological management is crucial to improve the prognosis in these highly complex reconstructive cases.

Conflict of Interest

Not available.

Financial Support

Not available.

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How to Cite This Article
Núria CT. Cerebrospinal fluid fistula reconstruction at the skull base using free rectus abdominis flap: A case report. International Journal of Case Reports in Surgery. 2025;7(2):97-100.