"A NOVEL CORONAL EXTENDED ENDONASAL APPROACH TO THE ANTERIOR CRANIAL FOSSA: PRESERVATION OF THE OLFACTORY NERVE USING A MUCOSAL-OSSEOUS-DURAL-NEURAL FLAP IN AN ANATOMICAL STUDY INSPIRED BY SARCOPHAGUS DOORS".

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Abstract

The present work aims to demonstrate a novel endonasal route that allows approach to the anterior fossa, avoiding the sacrifice the first pair, the olfactory nerve, as usually occurs during this type of surgery; given the completeness of the anatomy of this cranial nerve and its apparent lack of eloquence in the patients.

Introduction

The craniofacial skeleton originates from both neural crest–derived mesenchyme and paraxial mesoderm, the skull base being defined by the passage of neural elements. In the prechordal area, the olfactory nerve (I) passes through the cribriform plate. Unlike other cranial nerves, the olfactory and optic nerves arise as direct extensions of the brain, retaining meningeal coverings and a subarachnoid space, which renders them especially vulnerable in surgery, particularly in adult patients.

Anatomically and functionally, the olfactory system (rhinencephalon) is vital for sensory integration, survival, and behavior. Its components—the olfactory bulb, tract, striae, and linked cortical areas—constitute a mucosa–bone–neural complex that cannot be separated without loss of function. Consequently, the olfactory nerve should not be considered expendable but rather a crucial structure to preserve in anterior skull base approaches.

Methods and Materials

A narrative review of the literature was conducted to explore the olfactory nerve in terms of its neuroembryology, neuroanatomy, neurosemiology, and the clinical implications of its injury. In addition, an anatomical study was performed using initially carried out on real skulls, with a step by step description of techniques to preserve the olfactory nerve and avoid its sacrifice during anterior cranial fossa approaches, such as the transplanum sphenoidale and transcribriform approaches. The cadaveric dissections were complemented using morphometric analysis and the use of three-dimensional (3D) printed biomodels derived from real patients, allowing a more accurate evaluation of anatomical landmarks and surgical corridors.

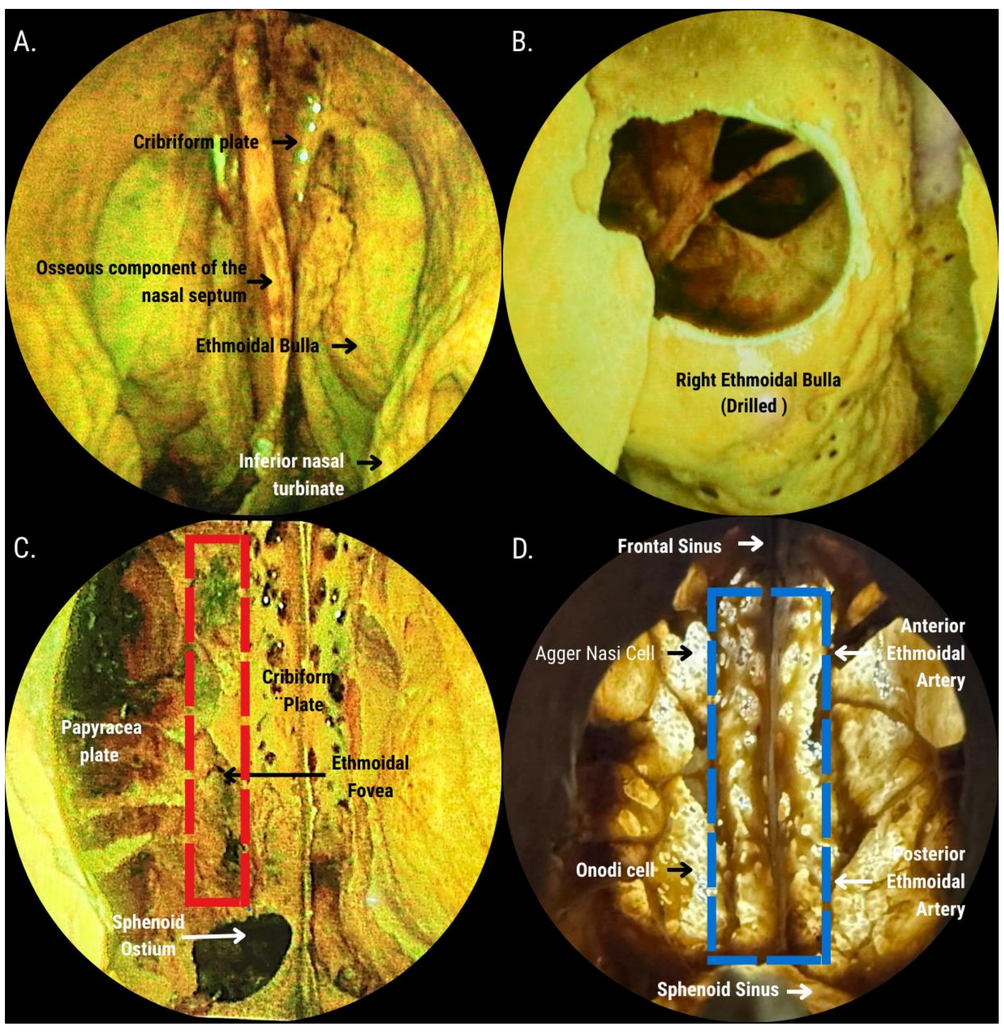

Figure 1. Bilateral extended endonasal approach to the anterior cranial fossa with identification of the main osseous landmarks. (A) In the initial view of the approach, the midline is identified at the parasagittal level of the nasal septum, along with the cribriform plate, which contains the olfactory nerve filaments, and the ethmoidal bulla. (B) Subsequently, progressive opening of the ethmoidal bulla is performed until the Onodi cell is identified, marking the beginning of the surgical corridor toward the agger nasi cell region through the ethmoidal fovea. (C) The corridor is further expanded along the ethmoidal fovea, as indicated by the red dotted line, maintaining the cribriform plate medially and the lamina papyracea laterally as anatomical boundaries. (D) Within the area delineated by the blue dotted line, the cribriform plate is visualized as a structure that must be carefully preserved, leaving both ethmoidal fovea corridors laterally; it is emphasized that the most posterior ethmoidal cell, located anterior to the sphenoid sinus, corresponds to the Onodi cell, through which the posterior ethmoidal artery may course, and that the most anterior ethmoidal fovea cell before the frontal sinus corresponds to the agger nasi cell, a region in which the anterior ethmoidal artery should be identified, as its location may be variable.

Results

Our study demonstrated that the first cranial nerve can be preserved in the coronal extended endonasal approach to the anterior cranial fossa, by following the proposed steps and maintaining the mucosal–osseous–neural flap of the olfactory nerve. Neurosemiological evaluation allows documentation of its integrity before and after surgery, confirming that its injury significantly impacts patients' quality of life when the nerve is sacrificed.

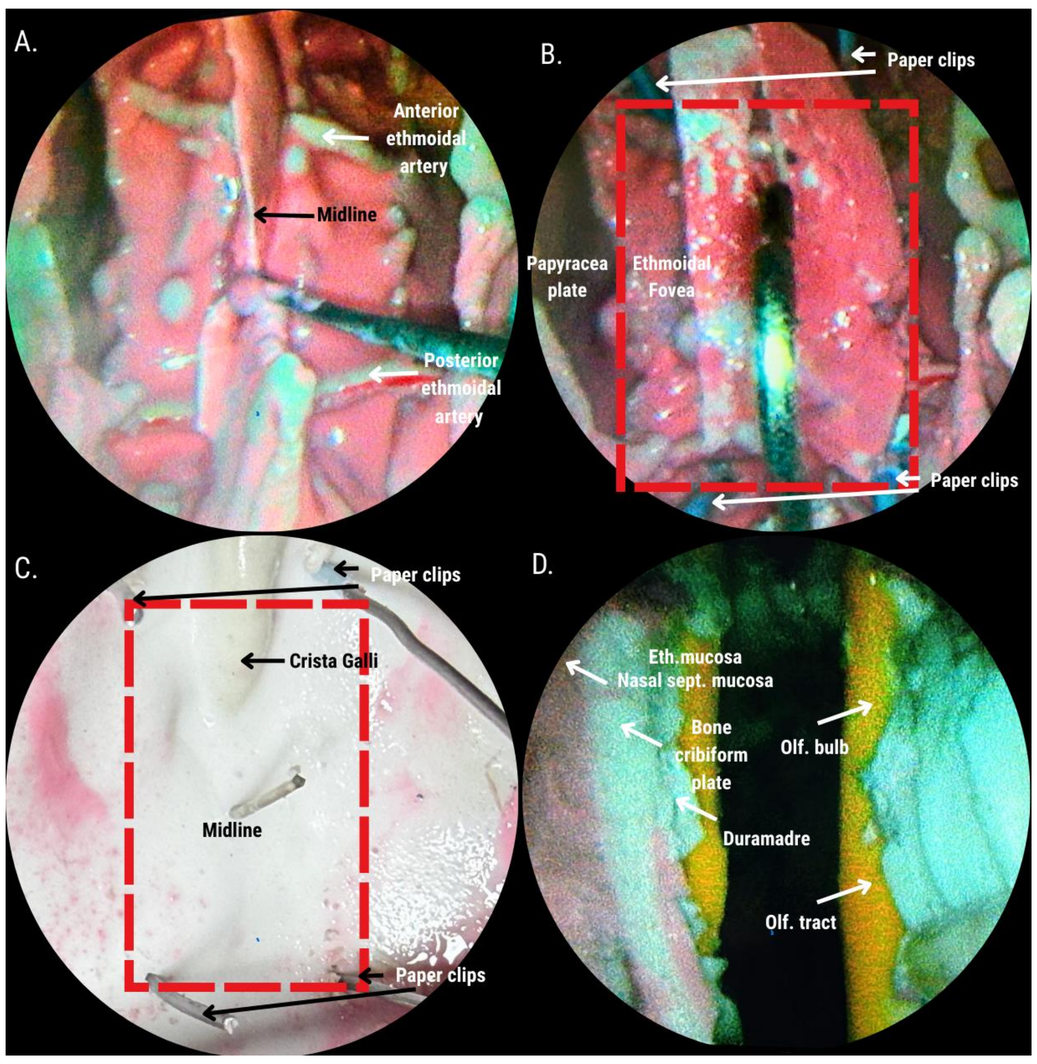

Figure 2. Photographs obtained from 3D-printed biomodels with reconstruction of the nasal mucosa and dura mater using silicone. (A) Panoramic endonasal view demonstrating both the anterior and posterior ethmoidal arteries and the midline; at this stage, the nasal septum has been drilled and approximately 12 mm of nasoseptal mucosa have been dissected down to the horizontal plate of the ethmoid. (B) The red dotted line delineates the osteotomy sites, with the anterior osteotomy performed anterior to the anterior ethmoidal artery and the posterior osteotomy posterior to the posterior ethmoidal artery; lateral cuts are made at the junction between the lamina papyracea and the ethmoidal fovea, preserving the cribriform plate and the 12 mm nasoseptal strip to protect the olfactory nerve, while drilling of the crista galli is required at this step. (C) Intracranial view of the clips, with the anterior clips entering through the agger nasi cell and the posterior clips through the Onodi cell. (D) Visualization of the opening of the "sarcophagus door," The dura mater is opened in an H-shape, leaving the dura intact in contact with the lateral walls, revealing the mucosal, osseous, dural, and neural flap.

Discussion

This represents the first craniotomy technique reported for skull base access to the extended anterior cranial fossa; it not only aims to preserve the olfactory nerve but also creates a flap for this region supplied by four vascular pedicles. The anatomical dissection study was first performed on cadaveric skulls to delineate bony landmarks and was subsequently supplemented by replicating the same procedure on 3D-printed biomodels incorporating soft tissues such as dura mater and mucosa, demonstrating that these approaches are feasible and advisable for eventual application in live humans. Neurosemiological assessment permits objective documentation of olfactory function before and after surgery, and should be performed to support postoperative appraisal of nerve integrity. Preservation of the olfactory nerve is clinically important, since its sacrifice substantially diminishes patients' quality of life and affects social, nutritional, and safety-related daily activities and independence.

Conclusions

In extended endonasal approaches to the anterior cranial fossa, particularly via the transplanum and transcribriform corridors, preservation of the olfactory nerve is achievable with the technique we propose. By adhering to the outlined anatomical steps and employing the proposed mucosal–osseous–dural–neural flap as a reliable safety landmark, surgeons can obtain safe access to these regions while minimizing functional impairment.

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