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Research Article

Skull Base Reconstruction with Bipedicle Middle Turbinate Flap

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Abstract

Anterior skull base repair with flaps has a high success rate.

The bipedicle middle turbinate flap has a double irrigation that comes from the middle turbinal branch originating from the posterolateronasal artery and from branches of the ethmoid arteries, which increases the security of the flap.

Objective: To determine the efficacy of the bipedicle middle turbinate rotary flap to repair lateral and medial defects of the anterior skull base.

Material and Method: Through the review of the electronic medical records, the patients who had defects at the anterior skull base, and who were reconstructed with a bipedicle middle turbinate rotary flap were selected. The surgeries were performed between June 2018 to October 2020.

Results: Four reconstructions of the anterior skull base were made with a bipedicle rotary mucoperiosteal flap of the middle turbinate. The defects were small or medium (<3 cm) and were located on the ethmoid roof (3/4) and in the frontal sinus (1/4).

The success rate of the reconstructions was 100%.

Conclusions: The bipedicle middle turbinate flap with medial or lateral rotation is an effective, fast and simple technique to repair small or medium defects, located at the anterior skull base.

Keywords: Middle Turbinate; Flap; Skull Base; Cerebrospinal Fluid Fistula

Introduction

Repair of defects in the anterior skull base can be performed with different tissues and heterologous materials with a similar success rate, especially in small defects.

The nasoseptal flap with a pedicle in the posterior septal artery is one of the most used, possibly for the ease of its dissection, its great extension that allows to reconstruct skull base defects from the cribriform plate to the clivus, and its high success rate.

The use of this flap leaves a raw area without mucoperiosteum which is prone to crusting and although it is infrequent, it can leave septal perforations as a sequel.

In small and medium defects of the anterior skull base, sphenoid plane, and sellar region, the middle turbinate mucoperiosteal flap is an option for reconstruction, especially in cases of previous septal surgeries, septal perforations, and wide sphenoid antrostomies in which the posterior septal artery could have been sacrificed.

Objective

To determine the efficacy of the bipedicle middle turbinate rotatory flap to repair lateral and medial defects in the anterior skull base.

Design

Descriptive and retrospective.

Methods

Through the review of electronic medical records, patients who had defects in the anterior skull base and who were reconstructed with a bipedicle middle turbinate flap were selected.

Surgeries were performed between June 2018 and October 2020, by the Rhinosinusology and Skull Base Section of the Otorhinolaryngology service of the Italian Hospital of Buenos Aires.

All patients were evaluated by nasal endoscopy and computed tomography (CT), and two also with magnetic resonance imaging, to determine the location and size of the defect in the anterior skull base.

Under general anesthesia, by endonasal approach with 0º endoscopes, the defect was located at the base of the skull and the surrounding mucosa was excised, leaving the bone exposed.

A vertical incision was made in the anterior sector of the middle turbinate, 5 mm above the axilla to the lower border, and then a lateral and medial subperiosteal dissection was performed, resecting the underlying bone (Figure 1).

Figure 1: Bipedicle middle turbinate mucoperiosteal flap. A: Anterior incision, B: Medial and lateral subperiosteal dissection, C, D: Turbinal bone resection.

According to the location of the defect to be repaired in the anterior skull base, the bipedicle middle turbinate flap was rotated.

Lateral defects to the middle turbinate were reconstructed with medial flaps and the medial defects with lateral flaps.

In the medial defects, intradural fat extracted from the ear lobe was also placed prior to the rotation of the flap (multilayer reconstruction).

Synthetic hydrogel was placed on the flap and then hemostatic matrix. A nasal plug was then placed to support the reconstruction and was removed after 4 days.

Antibiotics were indicated for 10 days and rest for 30 days, avoiding all activities that could increase intracranial pressure.

The patients were hospitalized in the intermediate therapy unit.

Controls were performed by nasal endoscopy and computed tomography.

The reconstruction was considered successful when there was no evidence of postoperative cranioliquorrhea, clinically or by endoscopy, and when the symptoms and pneumocephalus disappeared in the postoperative tomographic controls.

Results

Four skull base reconstructions were performed with bipedicled middle turbinate flap.

Three patients were women and one man, the average age was 63 years (37-94 years).

The etiologies were meningoceles 2/4, and pneumocephalus due to head trauma and post-surgery for meningioma of the anterior cranial fossa performed by external approach with obliteration of the frontal sinus (2/4).

The signs and symptoms that the patients had were: cranioliquorrhea (2/4), and pneumocephalus without cerebrospinal fluid fistula (2/4).

The defects were small or medium (<3 cm) and were located in the cribriform plate of the ethmoid (3/4) and in the posterior wall of the frontal sinus (1/4).

In two the mucoperiosteal flap was rotated laterally to obliterate the frontal ostium after a Draf I, and in another to repair a 2.5 x 2 cm defect in the cribriform plate lateral to the middle turbinate caused by a head trauma (Figure 2, 3).

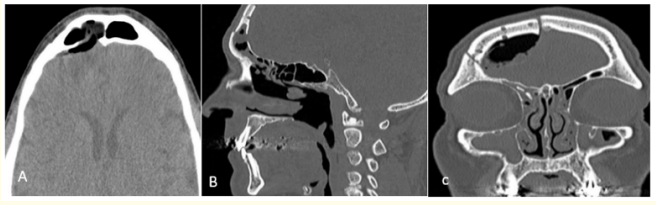

Figure 2: Middle turbinate flap with lateral rotation.
A, B, C: Postoperative pneumocephalus after craniotomy and frontal sinus obliteration. D: Lateral rotation of the flap to block the frontal ostium.

Figure 3: Middle turbinate flap with medial rotation.
A, B: Pneumocephalus, C: Skull base defect (arrow), D: Lateral middle turbinate flap, E: Medial rotation of the flap, F: Hemostatic matrix placed on the flap.

In patients with meningoceles located in the cribriform plate medial to the middle turbinate, the size of the defects was 1x1 centimeters.

After reducing the meningoceles with bipolar, the surrounding mucosa was resected and the bone was expose. Intradural fat was placed, and the flap was rotated medially (intra and extradural multilayer reconstruction) (Figure 4, 5).

Figure 4: Middle turbinate flap with medial rotation.
A: CT where it is observed a left cribriform plate meningocele (arrow), B: Endoscopic view of meningocele (arrow), C: Reduction of meningocele and exposure of surrounding bone, D: Intradural fat placement, E, F: Lateral middle turbinate flap reconstruction. Meningocele Ethmoid meningocele (arrow). Multilayer repair with intradural fat and lateral extradural middle turbinate mucoperiosteal flap.

Figure 5: Cribriform plate meningocele.
A: Endoscopic vision of the meningocele, B: Bipolar reduction, C: Adjacent mucosa resection and exposure of the surrounding bone, D: Intradural fat placement, E: Bipedicle lateral middle turbinate flap reconstruction of skull base.

The patients were hospitalized for 6 days on average, and had no complications during surgery or in the postoperative period.

The 94-year-old woman died 60 days later from causes other than head trauma without pneumocephalus or CSF leak, and the other three patients were followed for an average of 2 years with no evidence of cranioliquorrhea or pneumocephalus.

Sex	Age	Sign/symptom	Reconstruction site	Rotation	Complications	Success rate
F	62	Craneoliquorrhea	Cribriform plate/Meningocele	Medial	Not	Yes
F	94	Pneumocephalus	Cribriform plate /trauma	Medial	Not	Yes
F	37	Craneoliquorrhea	Cribriform plate/Meningocele	Medial	Not	Yes
M	59	Pneumocephalus	Frontal sinus floor	Lateral	Not	Yes

Table 1: Skull base reconstruction with the bipedicle middle turbinate flap.

Discussion

Endonasal endoscopic surgery has expanded its indications, becoming a widely used technique to treat pathologies that compromise the skull base.

Most skull base defects less than 1 cm can be repaired satisfactorily (>90% success) with grafts or flaps.

Success in these cases is independent of the method and the material used for the reconstruction.

The incidence of postoperative cerebrospinal fluid fistulae due to major defects has decreased from 20-30% to less than 5% in reconstructions of the anterior skull base performed with vascularized flaps [1].

Due to their better vascularization, flaps are the choice to reconstruct defects larger than 1 cm, high-flow fistulas, or to carry out repairs in patients who have been or will be treated with chemotherapy and/or radiotherapy.

Since the description of the nasoseptal flap by Hadad-Bassagasteguy doctors, other local and regional flaps have been described [2].

The middle turbinate mucoperiosteal flap was described by Prevedello., *et al*. [3] in 2009. It can be used to repair defects in the sellar region, fovea ethmoidalis, cribriform plate, and sphenoid plane. The average length and width of the flap can be 4.04 x 2.8 cm.

It has a posterior pedicle, which is the branch to the middle turbinate originating from the posterolateranasal artery, branch of the sphenopalatine artery.

If the pedicle is dissected posteriorly to the sphenopalatine foramen, the flap length is increased.

Other studies described that the main irrigation of the medial mucoperiosteum of the middle turbinate comes from the anterior, posterior and middle ethmoidal arteries when it exists, and the irrigation of the lateral sector is produced throught the middle turbinal branch of the posterolateronasal artery.

Both sectors have one or more anastomoses at the anteroinferior border of the middle turbinate [4,5].

Medial or lateral mucoperiosteum dissection and hinged rotation of the flap, allows preservation of both vascular pedicles, increasing the safety of the flap and even in cases of injury to the posterior pedicle, the flap can maintain its vitality.

In most studies, they use the middle turbinate flap with a posterior pedicle [3,6,7].

Possibly this is the best technique for the flap to reach the sellar region.

In reconstructions of the ethmoidal fovea or cribriform plate, the medial or lateral rotation of the flap allows the skull base to be repaired while preserving the two vascular pedicles.

Only the study of Schreiber [4] describes this type of bipedicle flap used to repair a defect in the ethmoid roof.

The advantages of this flap are that it can be used when the sphenopalatine artery has been damaged (irrigated by ethmoid arteries), and that it is located in the same surgical field than the defect to be repaired.

Disadvantages are that flap dissection may be more difficult if the bony attachment of the middle turbinate becomes destabilized.

There may also be anatomical variants (25%) [8] that can make dissection difficult: bullous, paradoxical, or hypoplastic turbinate.

In many endonasal approaches to the skull base, middle turbinectomy is a step in the surgical technique. We believe that the middle turbinate should not be routinely resected so as not to invalidate an important method of skull base reconstruction.

In one study [9] they reported a 100% success rate in skull base reconstruction with posterior pedicle middle turbinate flap. Twenty patients had cerebrospinal fluid leaks located in the cribriform plate, lateral to the lamella of the middle turbinate (11/20), medial to the lamella (3/20), and in the sellar region (6/20).

Simal [10] reported successful skull base reconstruction in 10 patients with a posterior pedicle middle turbinate flap after endoscopic approaches to the sellar and suprasellar.

Conclusions

- The bipedicle medial or lateral mucoperiosteal flap of the middle turbinate is an effective, fast and simple technique to repair small or medium defects located in the anterior skull base.
- The success rate we had in skull base reconstructions was 100% and without complications.
- The rotation of the middle turbinate flap in the form of a "hinge" makes it possible to conserve the irrigation of two vascular pedicles, increasing the flap vitality.

Declare of Conflicts of Interest

I have no conflicts of interest.

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