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Skull Base Reconstruction After Endoscopic Endonasal Skull Base Surgery

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ORIGINAL ARTICLE

Skull-base Reconstruction After Endoscopic Endonasal Skull-base Surgery

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Abstract

Background: Cerebrospinal fluid (CSF) leakage following surgery is a known potential complication associated with substantial morbidity and mortality. Numerous techniques for prevention and treatment after endoscopic skull-base surgery are described. These include lumbar drain, autologous grafts like fat, muscle, and fascia and synthetic materials like a polyester-silicon dural substitute. But these grafts alone were associated with a high failure rate, particularly in large defects. The application of vascularized flaps promotes more rapid and complete healing and was associated with a sharp decrease in CSF leaks. These vascularized flaps include nasoseptal, inferior turbinate, and pericranial flaps. The most common nasoseptal flap is that depends on the nasoseptal artery.

Aim: The aim of the study is to decrease the CSF leakage frequency following an endoscopic endonasal skull-base operation by endoscopic skull-base reconstruction and evaluate the different and recent modalities of skull-base reconstruction.

Patients and methods: It is a prospective cross-sectional observational study, where 30 diseased persons with middle and anterior skull-base lesions undergo skull-base reconstruction following endoscopic endonasal skull-base surgical operation.

Results: Intraoperative CSF leakage occurred in nine (30 %) patients. Only two (8 %) cases had postoperative CSF leaks and needed reconstruction.

Conclusion: Skull-base complications require accurate and long-lasting repair after endoscopic skull-base tumor removal.

Keywords: Endoscopic surgery, Reconstruction, Skull base

1. Introduction

With the advent of endoscopic endonasal surgery, skull-base surgery has been transformed. These methods were first used for paranasal sinus surgery, but their application has been gradually expanded to encompass endoscopic excision of pituitary tumors, as well as planum sphenoidal, olfactory cleft, the petrous apex, clival lesions, and the infratemporal fossa.¹

The pathology in the sellar, parasellar, and suprasellar regions includes neoplastic, inflammatory, infectious, developmental, and vascular defects, and also different lesion presentations. Clinically,

endocrinologically, and radiologically, the presentations can be similar. Nonetheless, pituitary adenoma is the most prevalent sella turcica lesion.²

Significant benefits of endoscopic endonasal technique over the traditional surgical one involve more direct midline exposure, better access to deep-seated lesions, less trauma to neurovascular systems, reduced brain tissue trauma, and quicker optical device decompression and enhanced masses devascularization from their environments.³

Cerebrospinal fluid (CSF) leakage is the most common postoperative consequence of the endoscopic technique. CSF leaks can be classified into high-flow and low-flow leaks. Low-flow CSF

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leakage occurs only in a few drops after transient intracranial pressure elevation. High-flow CSF leakage is the persistent CSF flow out intra-operatively with a wide cistern defect or ventricular opening.⁴

In some instances, sellar reconstruction is made to build a protective barrier, decreasing the dead space, and preventing the chiasm from descending into the sellar cavity. It is necessary when an intra-operative CSF leakage occurs or when there is presence of a large cavity following tumor removal. Various techniques are used, including intradural and/or extradural sella closure and sella packing with or without sphenoid sinus packing. This technique is considered as minimally invasive but highly effective for pituitary lesions.¹

The growing experience and the recent development of the optical devices and instruments in the field of transsphenoidal surgery allow the development of recent and safer approaches for the sella and skull base. Young neurosurgeons should learn this endoscopic procedure, which provides them with all the opportunities and encouragement they require to progress in this profession. The main aim was to study how to decrease the CSF leakage following endoscopic endonasal skull-base surgery by endoscopic skull-base reconstruction and evaluate the various and recent modalities of skull-base reconstruction.

2. Patients and methods

This prospective, cross-sectional observational research investigated skull-base repair following endoscopic endonasal skull-base surgery in Al-Azhar University Hospitals.

The study included 30 patients with anterior and middle skull-base lesions. MRI with i.v. contrast is considered the gold standard method and was done for all the studied cases. It provides data about the suprasellar extensions and vascular invasions.

All the enrolled patients had computed tomography (CT) brain with bone window (coronal and axial) and CT of paranasal sinuses. Axial and coronal CT examinations allow the evaluation of the rhinosinus symmetry, architecture, and the sphenoid sinus ventilation.

2.1. Operative procedure

With orotracheal intubation and under general anesthesia, the case was supine with the head angled 15° toward the surgeon and 15° toward the opposite shoulder.

Through the nostril, a rigid 0° endoscope, 18 cm in length and 4 mm in diameter was inserted. After the creation of adequate space between the nasal septum and the middle turbinate, the endoscope was angled upward along the sphenoid recess and the choana roof till reaching the sphenoid ostium, which is typically located ~1.5 cm above the choana roof. Lateral dissection for the mucosa over the sphenoid face between the two ostia, the most posterior 1 cm of the nasal septum and an anterior sphenoidotomy with 1 cm of the nasal septum's posterior portion removal. Following sphenoidotomy, the sphenoid septum was removed, exposing the lateral and posterior walls of the sinus, with the sellar floor in the middle. The sellar floor aperture has been created but must be extended, if necessary. Midline, straight, or cruciate incisions were done in the dura.

The pathology excision was done in sequence. In the case of CSF leakage, a multilayered repair was done. Glue may be used to keep the tissues together. The grafting types include overlay, underlay, and combined. In an 'underlay' or 'inlay' method, the intact dura is dissected from the defect's edge to expose sufficient space for graft stability. The free flap or graft must be larger than the defect; so, it can be pushed a few millimeters between the bone and the dura on all sides of the lesion.

Rates of postoperative CSF leaks are initially decreased by the nasoseptal flap, with a high success rate following the reconstruction of intra-operative CSF leaks. Reconstruction with the adhesive dural graft was also used.

Even if there is no CSF leakage, the hollow may be sealed with fat to prevent postoperative CSF leak from the delayed arachnoid membrane rupture and the sella syndrome.

At the end of the procedure, hemostasis was accomplished, and the nose was irrigated. In addition, the endoscope was removed gradually, and the middle turbinate was softly medialized. After 48 h, the nasal cavity packing should be removed.

Al-Azhar University Ethics Board revised and approved the research.

2.2. Statistical analysis

Data were analyzed by SPSS (Version 20; Echo-soft Corp., Armonk, New York, USA). Qualitative data were demonstrated as absolute numbers and percentages whereas quantitative data were presented as mean \pm SD. The following procedures were carried out: Student *t*-test for comparing means of two groups with parametric data. The Spearman ranked correlation test can be used to investigate the

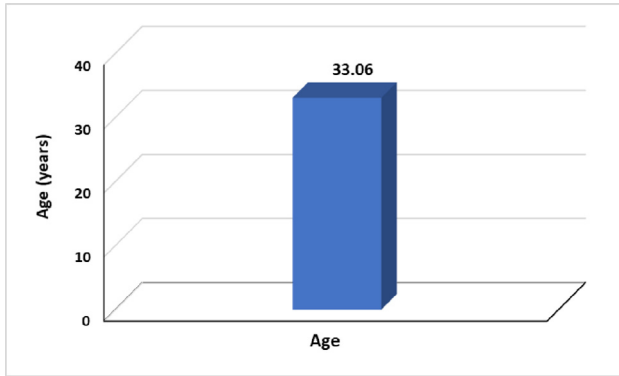


Fig. 1. Mean age of the studied patients.

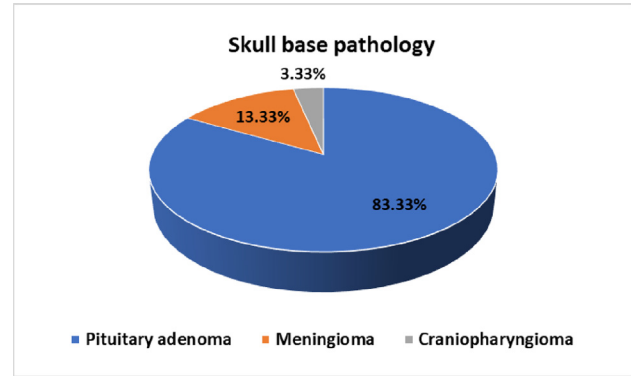


Fig. 3. Skull-base pathology of the studied patients.

possible relationship between each pair of variables in each category. The χ^2 test was utilized for analyzing the relationship between any two variables or comparing any two categorical groupings. *P* value less than 0.05 was considered significant.

3. Results

Thirty individuals had endoscopic endonasal transsphenoidal surgery in this research. Their mean age was 33.06 ± 12.8 years, ranging from 18 to 57 years (Fig. 1).

Twenty-one (70 %) patients had headache, 25 (83.33 %) had blurring and diminution of vision, six (20 %) had visual field defect, two (6.67 %) had increased size of extremities, six (20 %) had secondary amenorrhea, three (10 %) had menstrual irregularity, seven (23.33 %) had galactorrhea, two

(6.67 %) had facial deformity, two (6.67 %) had erectile dysfunction, one (3.33 %) had double vision, one (3.33 %) had lactation failure, one (3.33 %) had gynecomastia, one (3.33 %) had loss of libido, one (3.33 %) had loss of axillary and pubic hair, one (3.33 %) had right eye squint, one (3.33 %) had vomiting, and one (3.33 %) had weight gain (Fig. 2).

There were 25 (83.33 %) cases of pituitary adenoma, four (13.33 %) cases of meningioma, one (3.33 %) case of craniopharyngioma (Fig. 3).

There are seven (23.33 %) cases reconstructed with the artificial dural graft, 11 (36.67 %) cases reconstructed with the fascia lata and fibrin glue, two (6.67 %) cases reconstructed with fat and fibrin glue, five (16.67 %) cases reconstructed with the nasoseptal flap, and five (16.67 %) cases without reconstruction, only hemostasis and nasal packing (Fig. 4).

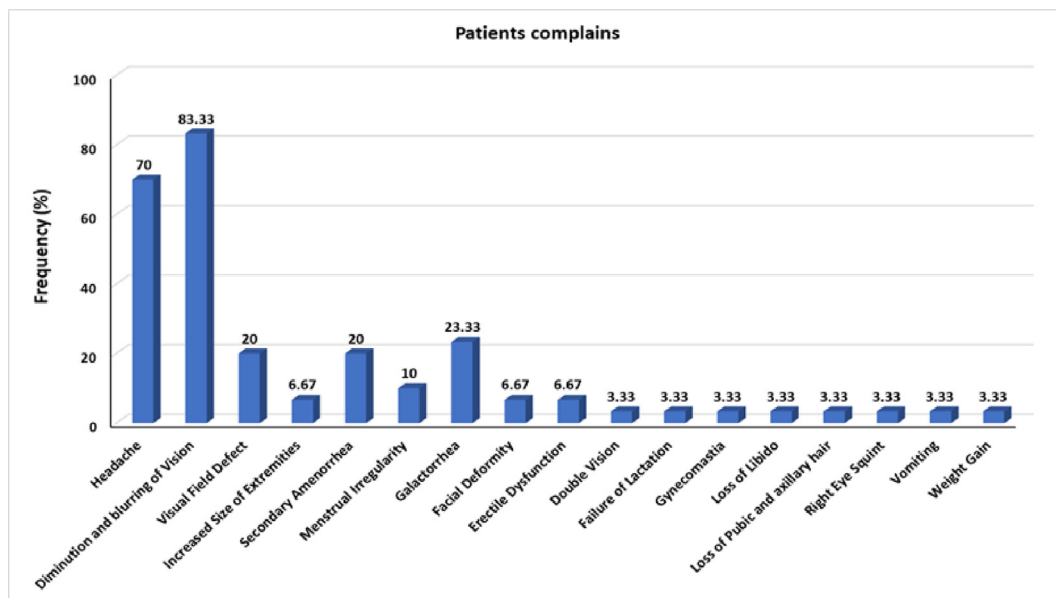


Fig. 2. Frequency of patients complains of the studied patients.

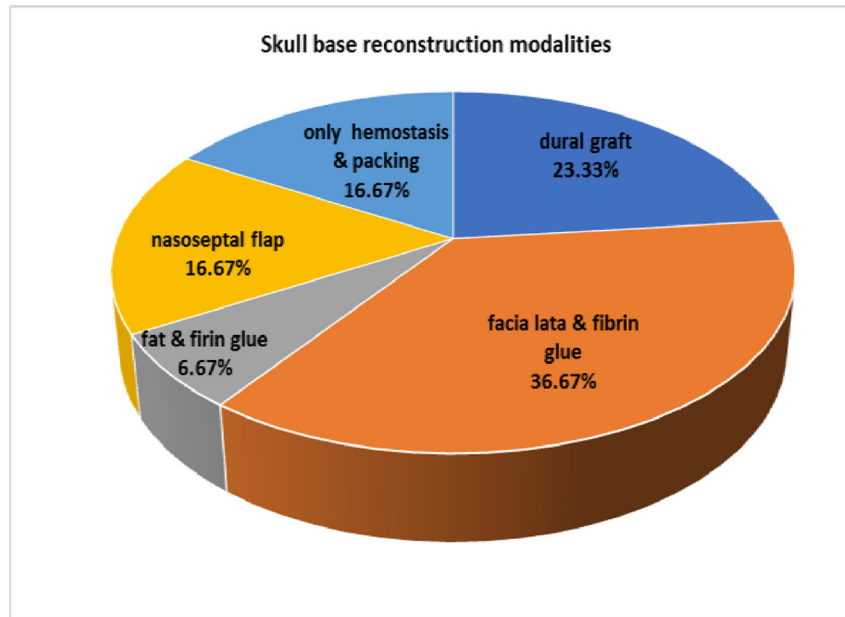


Fig. 4. Skull-base reconstruction modalities of the studied patients.

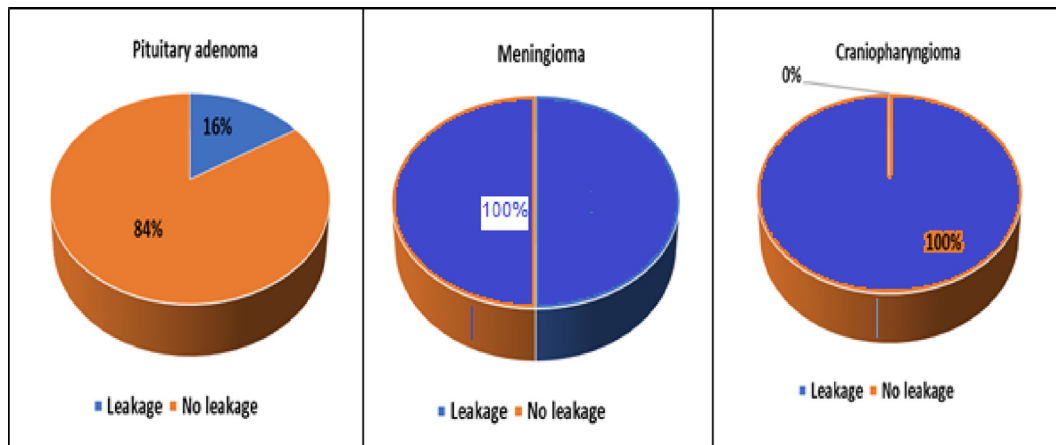


Fig. 5. CSF leak in the studied patients. CSF, cerebrospinal fluid.

CSF leakage occurred in nine (30 %) patients of the study group. There were four (16 %) cases of pituitary adenoma that had CSF leak, four (100 %) cases of meningioma, and one (100 %) case with craniopharyngioma as demonstrated in Fig. 5.

Out of 25 cases that needed reconstruction only two (8 %) cases had postoperative CSF leaks (Fig. 6).

There were two (18.2 %) cases of facia lata and fibrin glue who had postoperative CSF leakage, 0 (0 %) postoperative CSF leak cases with dural graft, fat, and fibrin glue, and with the nasoseptal flap. There was no significant association between the postoperative CSF leak the type of reconstruction ($P = 0.74$) (Fig. 7).

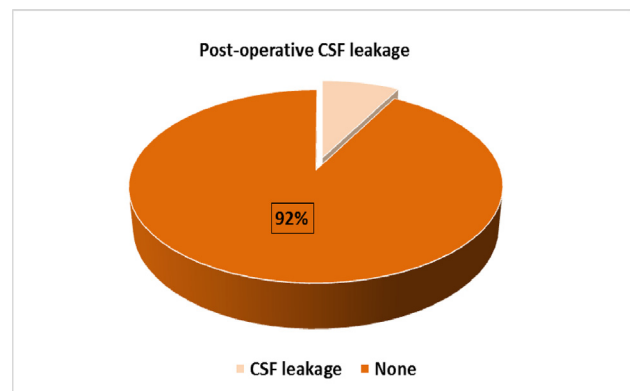


Fig. 6. Frequency of postoperative CSF leak in the studied patients. CSF, cerebrospinal fluid.

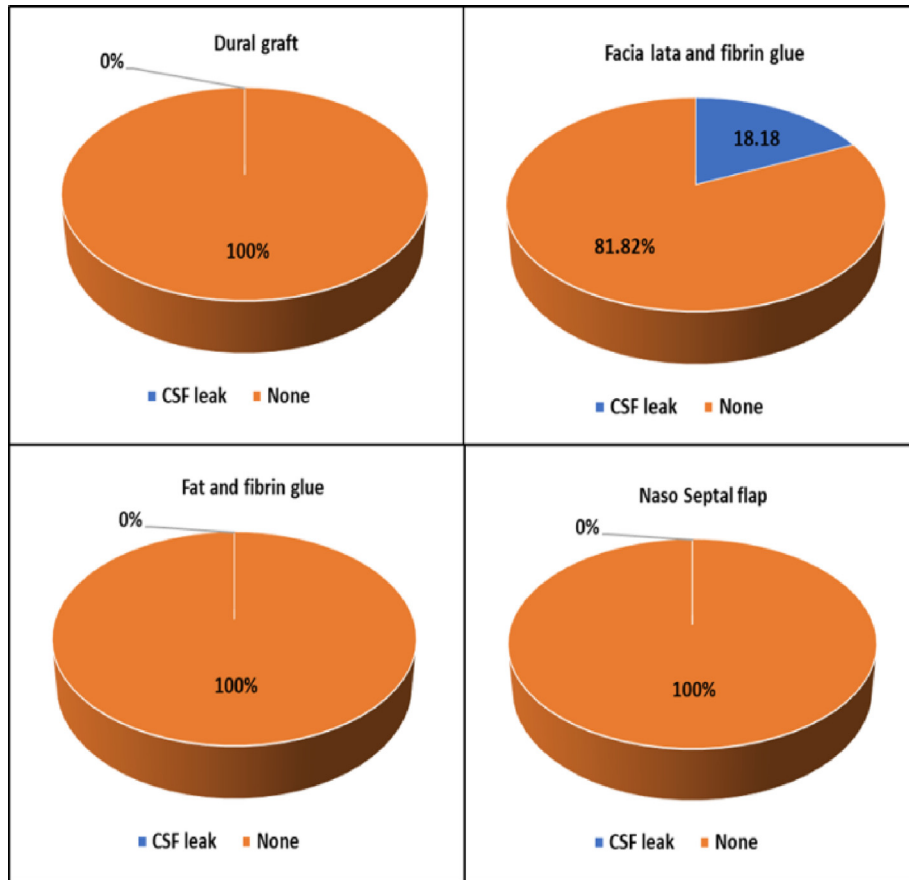


Fig. 7. Distribution of postoperative CSF leakage in the type of reconstruction of the studied patients.

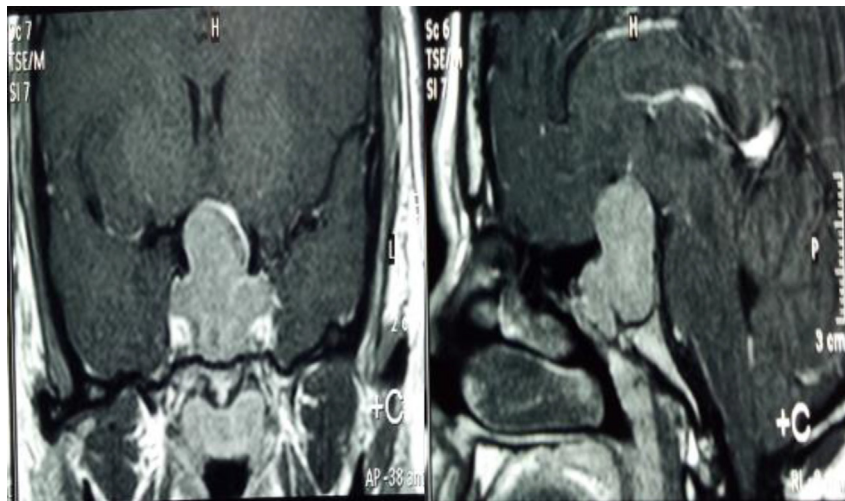


Fig. 8. Coronal and saggital MRI view of pituitary adenoma.

4. Discussion

This prospective research investigated skull-base reconstruction following endoscopic endonasal skull-base surgery at Al-Azhar University Hospitals.

Regarding epidemiologic findings, the majority of cases were females, 19 (63.33 %) and 11 (36.67 %) cases were males. In our series, the mean age of the studied cases was 33.06 ± 12.8 years, ranging from 18 to 57 years. The mean age was 45 years and

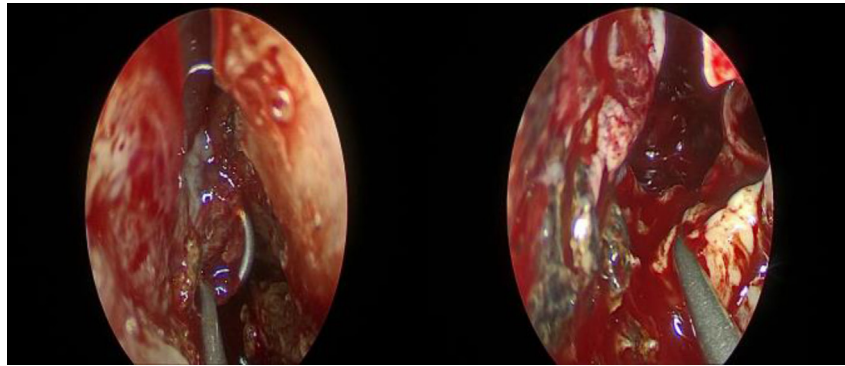


Fig. 9. Intraoperative endoscopic view of excision of pituitary adenoma.

ranged from 18 to 65 years in a study performed by Phogat et al.⁵ In our study, visual symptoms were the foremost frequent symptom, and it was reported in 25 (80.33 %) patients, these results are similar to those of Sriram et al.⁶

Headache was the second most frequent presentation as 21 (70 %) patients had headaches. The intensity of the headache ranged from mild to severe. Headache was recorded in 76 % of cases in a massive literature analysis conducted by Rotariu et al.⁷ and Pal et al.⁸

MRI with i.v. contrast is considered the test of choice and was done for all studied cases. It provides data about suprasellar extensions and vascular invasions.

All the enrolled cases had CT brain with bone window (coronal and axial) and CT for paranasal sinuses. Axial and coronal CT examinations permit evaluation of the rhinosinus symmetry, architecture, and the sphenoid sinus ventilation (Fig. 8).

In our study, the surgery began with the sphenoid ostium expansion; therefore, there was no incision in the nasal mucosa, and reducing the risk of nasal problems. Our endonasal technique involved a parasseptal approach medial to the middle turbinate. The inferior edge of the middle turbinate served as a surgical reference point for the sella. A modest anterior sphenoidotomy incision exposed the posterior sphenoidal sinus wall.

It is possible to apply the bilateral transnasal endoscopic technique. In our series, endoscope holders were not used, so they may be rapidly relocated, as mobility is one of the most significant benefits of the endoscope. Patients who underwent empirical sellar repair without an intraoperative leak developed no postoperative leakage (Fig. 9).

In our study, reconstruction was done with the dural graft, facia lata, fibrin glue, fat, nasosepal flap, and hemostatic mattresses like gel foam or surgical in 25 (83.33 %) patients, for the other five (16.67 %) patients, just hemostasis and nasal packing.

In our study, there are seven (23.33 %) cases reconstructed with the dural graft, 11 (36.67 %) cases reconstructed with facia lata and fibrin glue, two (6.67 %) cases reconstructed with fat and fibrin glue, five (16.67 %) cases reconstructed with the nasoseptal flap, and five (16.67 %) cases without reconstruction, only hemostasis and nasal packing.

In our study, we attempt to prevent CSF leakage and drooping of the arachnoid membrane or chiasm by packing the sella with a fat graft.

Facia lata graft is used more than the adhesive dural graft in the reconstruction of pituitary adenoma. The case of craniopharyngioma was repaired with a fascia lata graft, without postoperative CSF leakage.

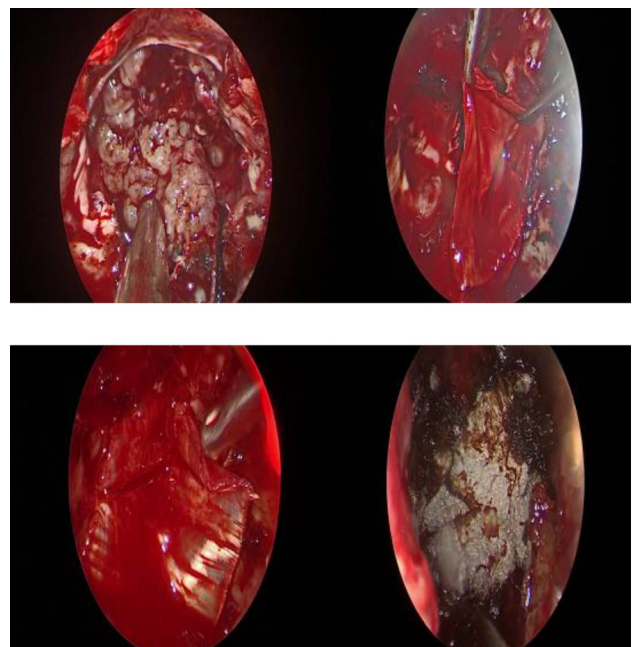


Fig. 10. Intraoperative endoscopic view of suprasellar meningioma removal and reconstruction with facia lata.

The recurrent pituitary adenoma was repaired with an adhesive dural graft and fibrin glue. Pituitary microadenoma did not need reconstruction, just proper hemostasis.

In cases with meningioma, two cases were repaired with fascia lata and fibrin glue. The other two cases were repaired with dural graft and fibrin glue, without postoperative CSF leakage.

Reconstruction with a nasoseptal flap is very efficient and gives a great result.

Our success rate of reconstruction and preventing CSF leakage is 93.33 % after the first surgery and 100 % after the second surgery (Fig. 10).

4.1. Conclusion

The endoscopic endonasal procedure facilitated complete tumor excision easier, improved the visual outcome, and reduced the complications. Reconstruction of skull-base defects remains the most challenging issue in this field. Complications, like CSF leak, meningitis, and tension pneumocephalus may occur if it fails to create an adequate reconstruction. All the sellar defects were large enough to accommodate an autologous graft and were repaired. The most effective free graft is the autologous fascia lata, due to its texture and thickness, which are similar to the dura. Sellar reconstruction is not required in all instances, but only in the presence of intraoperative CSF leakage or the presence of circumstances that may expose the patient to a similar event.

The nasoseptal flap has become the workhorse to close the CSF leaks and prevent postoperative leakage with a very high success rate.

Conflicts of interest

There are no conflicts of interest.

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