




# Sellar Floor Reconstruction with and without Intracellular Fat Packing after Endoscopic Resection of Large Pituitary Macroadenomas with Evident Intraoperative CSF Leak

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## Abstract

**Background** Intraoperative cerebrospinal fluid (CSF) leak is not uncommon with endoscopic transsphenoidal surgical excision of pituitary macroadenomas. How to seal the defect and prevent postoperative leak is still a matter of debate.

**Objectives** In patients with CSF leak, we tried to figure out which is more important in preventing postoperative leak, is it the sellar fat packing, is it tight repair of the sellar floor, or do we need to combine them both?

**Patients and Methods** Over 5 years, in patients with evident intraoperative CSF leak, with growing experience supported by positive postoperative results, we shifted gradually from intrasellar packing using combined fat graft and bioabsorbable materials (SURGICEL FIBRILLAR/Gelfoam) (group A,  $n = 15$ ) to only bioabsorbable materials (group B,  $n = 18$ ), either of which is followed by tight repair of the sellar floor.

**Results** Postoperative clinical assessment did not differ significantly between both groups at early, midterm, and long-term follow-up intervals. We did not have any patients with delayed postoperative CSF leak or symptomatic empty sella syndrome (ESS).

**Conclusion** There is no difference in the incidence of postoperative CSF leak and clinical ESS among both groups, indicating that tight sellar floor repair is more important than packing the sellar cavity with or without fat graft.

## Keywords

- ▶ Fat graft
- ▶ sellar floor
- ▶ CSF leak

## Introduction

Since the introduction of standard endoscopic endonasal transsphenoidal (EETS), the sellar cavity has been routinely packed with autologous and/or synthetic materials to act as barriers separating the intracranial cavity from nasal cavity

and paranasal sinuses to prevent cerebrospinal fluid (CSF) leak and secondary empty sella syndrome (ESS).<sup>1–3</sup>

In addition to skull base reconstruction, integrity of the diaphragma sellae itself is the main protector against postoperative CSF leak.<sup>4</sup> According to Couldwell, “the use of autologous grafting requires a second incision, prolongs

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operative time, and adds to the patient's postoperative discomfort. In addition, the presence of sellar packing may interfere with the interpretation of postoperative images.<sup>1</sup> Therefore, some authors started to reconstruct the sella using absorbable materials, such as gelfoam and/or surgical, only when there is no intraoperative CSF leak.<sup>2,4,5</sup>

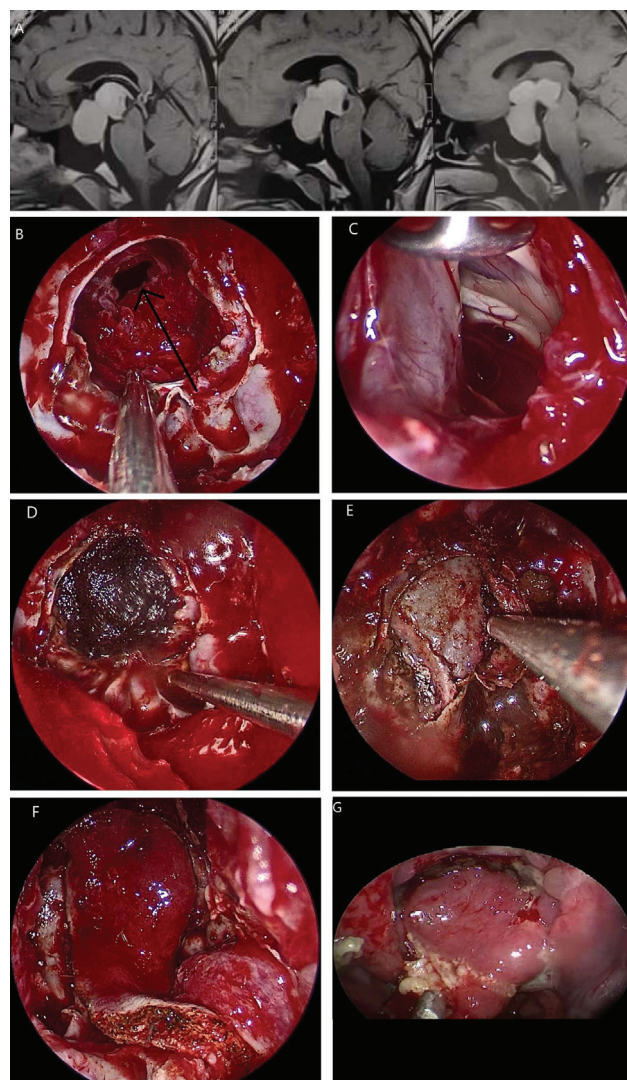
CSF leak is associated with increased risk of postoperative meningitis, especially with high-flow CSF leak or arachnoid opening  $\geq 5$  mm.<sup>6</sup> In such patients, tight closure is needed and requires multilayer technique, using fat, fascia lata, bone, mucoperiosteum taken from the middle turbinate, and vascular pedicle nasoseptal (Hadad-Bassagasteguy) flap.<sup>4,6-9</sup> In addition to autografts, synthetic and bioabsorbable materials have been also used to tightly repair the sellar floor with and without external CSF lumbar drain.<sup>10-17</sup>

Here, we aimed at evaluation of tight sellar floor reconstruction with and without sellar cavity fat packing after resection of pituitary adenomas in patients with evident intraoperative CSF leak. We tried to figure out which is more important in preventing postoperative leak, is it the fat plug, is it tight repair, or a combination of both?

## Patients and Methods

This is a retrospective study on 33 patients with evident intraoperative CSF leak during endoscopic resection of pituitary adenomas. We operated these patients at the neurosurgery department, Minia University Hospital, Egypt from January 2015 to December 2019. This study represents the authors' learning/experience curve over the last 5 years. We used the CSF leak grading system proposed by Kong et al in which grade 1 involves low-flow CSF leaks, resulting from arachnoid membrane defects less than 5 mm, while grade 2 involves high-flow CSF leaks from arachnoid defects of 5 mm or more.<sup>6</sup>

In some of our initial patients with evident intraoperative CSF leak, which occurs iatrogenic, we judged this leak as "low-flow." In such low-flow leak, we felt that it is unnecessary to pack the sellar cavity with abdominal fat, as the leak could be stopped by packing the cavity with bioabsorbable materials (SURGICEL FIBRILLAR/Gelfoam), followed by tight reconstruction of the sellar floor with vomer rigid bone graft and mucosal flaps. Encouraged by positive postoperative results, we cautiously shifted from packing the sellar cavity with combined fat graft and bioabsorbable materials (group A,  $n=15$ ) to only bioabsorbable materials (group B,  $n=18$ ), even in patients with intentional opening of the diaphragma sellae during resection of large adenomas with suprasellar extension. In all patients, the sellar floor was routinely tightly reconstructed with the same technique of using vomer rigid bone graft acting as a buttress to the packing material, followed by mucosal flaps. We used vascularized nasoseptal (Hadad-Bassagasteguy) flap only in "high-flow" CSF leak and/or arachnoid opening  $\geq 5$  mm (8 patients) (► Fig. 1).<sup>8</sup>



**Fig. 1** Preoperative MRI showing macroadenoma extending to the third ventricle (A), excision of the tumor with an arrow pointing to the arachnoid opening (B), extracapsular dissection of the tumor from the optic chiasm and floor of the third ventricle (C), filling the sellar cavity with Fibrillar (D), vomer bone graft is wedged as a buttress at the sellar floor (E), nasoseptal (Hadad-Bassagasteguy) flap is placed over the bone to completely cover the sellar floor (F), endoscopic view of the nasoseptal flap on the 17th day postoperative showing complete healing with no cerebrospinal fluid leak (G).

Vascularized nasoseptal flap is our first option to seal off the sella. However, we used fascia lata grafts with "gasket-seal" technique in only two patients.<sup>7</sup> In the first patient, the nasoseptal flap was short pedicled and not covering the whole sellar opening, while the second patient developed pneumocephaly and needed second-stage operation to remove the devitalized nasoseptal flap and deair the pneumocephaly. This multilayer repair is held in place by nasal packs for 3 to 5 days after which the patient is examined for CSF rhinorrhea before discharge. The follow-up period ranged from 3 months to 5 years. We looked for postoperative CSF leak early postoperatively. In mid- and long-term follow ups, we looked for delayed CSF leak and/or symptomatic ESS.

## Results

According to the CSF leak grading system, group A had 15 patients (grade 1,  $n = 11$ , and grade 2,  $n = 4$ ). Group B had 18 patients (grade 1,  $n = 13$ , and grade 2,  $n = 5$ ). In group A, we had only one patient (intraoperative grade 1 leak) with minimal early postoperative CSF leak that stopped spontaneously. In group B, we had three patients with CSF leak, one of them stopped spontaneously. The second patient needed a two-day lumbar drain to cease the leak. These two patients had intraoperative grade 1 CSF leak. The third patient (with grade 2 leak) had apoplexy within huge adenoma, distorting the third ventricular floor, and developed ventricular pneumocephaly 6 days after surgery (one day after removal of nasal packs) and needed a second stage operation for deairing of the ventricles and reconstructing the sellar floor with double-layered fascia lata graft and bone cement in between after removing the devitalized nasoseptal flap. Only this patient with pneumocephaly developed meningitis and was treated with broad-spectrum antibiotics. None of our patients had postoperative visual deterioration, delayed CSF leak, or other symptoms attributable to secondary ESS.

## Discussion

The sellar region can be approached through transcranial and transsphenoidal approaches. However, since the introduction of the endoscope, and with exponential growth of the surgeons' knowledge and learning curves, the transsphenoidal approach is now considered the approach of choice to sellar region.<sup>18</sup> Although it is less invasive when compared to transcranial approach, it allows better exposure to the entire central skull base from the cerebriform plate to the first cervical spine.<sup>18,19</sup>

The collaboration between ENT surgeons and neurosurgeons with the concept of "two nostrils four hands technique" during the different stages of the operation minimizes the perioperative complications and allows better exposure of the sphenoid sinus and sellar region.<sup>19,20</sup>

Sellar reconstruction after the operation is mandatory to create a barrier between the cranial and sinonasal cavity. This step is even more critical when there is CSF leak to prevent meningitis.<sup>5</sup> This step passed through a process of development and evolution with a lot of used material and techniques.<sup>4-17,21</sup>

As stated by Kassam et al, the greatest threat to the graft used to reconstruct the sellar floor is the development of persistent CSF channel and/or migration of the graft itself, especially when the arachnoid is widely open.<sup>21</sup> Moreover, a permanent CSF diversion is indicated with elevated CSF pressure to avoid postoperative persistent fistula.

Based on all the above mentioned, we tried to answer an important question regarding endoscopic transsphenoidal excision of pituitary adenomas. In the presence of evident intraoperative CSF leak and absence of elevated CSF pressure, which is more essential to avoid? Postoperative CSF leak and

its complications? Is it tight plugging of the sellar cavity with fat as a nonabsorbable material? Is it tight repair of the sellar floor? Or must we tightly pack the sellar cavity with fat and tightly repair its floor too?

In the earlier patients of this study, we routinely packed the sellar cavity with fat graft whenever we had evident CSF leak intraoperatively, whether it is accidental puncture of the arachnoid or large intentional opening during resection of large adenomas. This step was also routinely followed by tight reconstruction of the sellar floor, with a vomer bone graft acting as a buttress to the packing material. The final step is to cover this bone graft with a mucosal flap. We used nasoseptal flaps in high-flow CSF leak. This multilayered repair was held in place by nasal packs for 3 to 5 days.

Later, with growing experience, we thought that with low-flow CSF leak due to accidental puncture or small opening of the arachnoid ( $< 5$  mm), plugging the sellar cavity with a bioabsorbable material (SURGICEL FIBRILLAR/Gelfoam) would have the same packing effect of fat and give the arachnoid enough time to heal before being absorbed if there is no infection or elevated CSF pressure. Routine closure is then done with vomer bone graft and mucosal flaps as usual. This technique excludes the donor site discomfort and misinterpretation of the fat in follow-up images.

Guided by the encouraging results and postoperative courses that did not differ from patients having fat grafts, we moved to the next step, dealing with larger arachnoid opening and high-flow CSF leak. We focused on strengthening the repair of the sellar floor rather than plugging the sellar cavity to prevent graft migration and/or development of CSF fistula, especially at dependent points, as stated by Kassam et al.<sup>21</sup> So, we added a layer of nasoseptal flap to wedge the vomer bone graft at the sellar floor which, in turn, acted as buttress to the above packing material.<sup>8</sup> We used fascia lata graft only in one patient when we had a short pedicled nasoseptal flap and in a second patient who developed pneumocephaly and required removal of devitalized nasoseptal flap in the second surgery.

Still, we did not notice any difference in the postoperative courses and outcomes between patients in both groups, irrespective of whether they had low-flow CSF leak (11 patients in group A vs. 13 patients in group B) or high-flow CSF leak (4 patients in group A vs. 5 patients in group B).

However, this study is a single-center study. Therefore, it is limited to a small number of patients operated upon by the authors. Also, this explains why the results are statistically insignificantly different between the two patients' groups.

## Conclusion

Based on the results of this study, which represents the authors' experience and learning curve as a team of neurosurgeons and ENT surgeons dealing with pituitary adenomas, we believe that with intraoperative CSF leak, it is essential to plug the sellar cavity with absorbable and/or nonabsorbable grafts but tight repair of the sellar floor is even more critical. In addition, packing the sellar cavity with

SURGICEL FIBRILLAR dose not differ from fat grafts in patients' postoperative courses and outcomes.

This study represents our experience and needs to be incorporated in a multicenter study involving patients with skull base lesions other than midline pituitary adenomas such as meningiomas and craniopharyngiomas before establishing a universally accepted guideline on how to deal with such issue.

#### Conflict of Interest

None declared.

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