Universalsellar anatomical reconstruction using the sellar floor flap after endoscopic pituitary adenoma surgery

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Abstract
Postoperative cerebrospinal fluid (CSF) leaks still occur in patients without intraoperative CSF leaks after endoscopic endonasal pituitary adenoma surgery. We propose a reconstructive technique, the sellar floor flap (SFF), for universal sellar anatomical reconstruction. A total of 113 patients without intraoperative CSF leaks after endoscopic endonasal pituitary adenoma surgery from July 2013 to June 2016 were reviewed: 43 underwent sellar reconstruction with the SFF (the SFF group) and 70 underwent sellar packing only (the nonreconstruction group). No case of postoperative CSF leak was reported in the SFF group, whereas 7 cases were reported in the nonreconstruction group ($P < .05$). The SFF is suitable for universal reconstruction after endoscopic endonasal pituitary adenoma surgery and may decrease postoperative CSF leak.

Keywords
pituitary adenoma, endoscopic endonasal surgery, cerebrospinal fluid leak, sellar reconstruction, anatomic repositioning

Statistical Analysis
The results were analyzed using GraphPad Prism 5.0 (GraphPad Software, La Jolla, California). Data are presented as mean ± SD. Statistical analysis was performed with the Student t test and the $\chi^2$ test with the Fisher exact test. $P < .05$ was considered statistically significant.

Materials and Methods
With approval by the institutional review board of Jinling Hospital, a review was conducted of 113 patients without intraoperative CSF leaks after endoscopic pituitary adenoma surgery that was performed from July 2013 to June 2016. The patients who underwent prior transsphenoidal surgery were excluded. All patients were followed up for at least 6 months. No patient was lost to follow-up.

Surgical Procedure for SFF
The surgical procedure for SFF is shown in Supplemental Video S1 (available in the online version of the article).

The SFF should be bounded by the anatomic landmarks, including the carotid protuberance, optic protuberance, optocarotid recess, and the clivus (Figure 1A). A horseshoe-shaped mucoperiosteal incision of the sellar floor was made with an electronic knife. The superior border of the incision was located below the optic protuberance and optocarotid recess. For the lateral borders, the incision was made along the medial edge of the carotid protuberance. The bone opening of the sellar floor was created in strict accordance with the horseshoe-shaped incision, using a high-speed microdrill with a diamond burr. Then, the flap was down-fractured (Figure 1B). Intraoperative CSF leaks were detected by performing the Valsalva maneuver and endoscopic observation. After tumor resection, the surgical cavity was packed with absorptive gelatin sponge. Then, the SFF was repositioned. Fibrin glue was used to secure the flap in the correct anatomical position (Figure 1C). Intraoperative images of the main procedures of the SFF are shown in Figure 2.
Results

We started performing sellar reconstruction with SFF in January 2015. Among the patients without intraoperative CSF leaks, 43 patients underwent reconstruction using SFF (the SFF group) and 70 patients underwent nonreconstruction (the NR group). The sellar defect was just packed with absorbable gelatin sponge in the NR group. In this study, the SFF could not be performed in 13 patients (23%) because of thin or absent bone of the sellar floor (n = 11) or unrecognizable anatomic landmarks (n = 2) (Figure 3). No significant differences in age, sex, tumor size, or suprasellar or parasellar extension were indicated between the 2 groups (Table 1). None of the patients in the SFF group developed postoperative CSF leak, whereas 10% (7/70) of those in the NR group developed postoperative CSF leak ($P = .043$) (Table 1). Postoperative CSF leaks were treated by lumbar CSF drainage (6 patients) or revision (1 patient).

Discussion

The appropriateness of sellar reconstruction in patients without intraoperative CSF leaks remains inconclusive. Most surgeons consider sellar reconstruction unnecessary in the absence of intraoperative CSF leak. To decrease postoperative CSF leaks, some surgeons perform universal reconstruction regardless of additional complications. We support the view that universal reconstruction is necessary. However, we oppose the additional complications of these reconstruction methods.

Postoperative CSF leak—although infrequent—can occur even in the patients without intraoperative CSF. Romero Adel et al.
et al\textsuperscript{3} reported that postoperative CSF leaks occurred in 6 patients (6/73, 8%), 3 (50\%) of whom were without intraoperative CSF leaks. Cappabianca et al\textsuperscript{4} reported postoperative patients (6/73, 8\%), 3 (50\%) of whom were without intraoperative contact with instruments.

The SFF is suitable for universal sellar reconstruction for several reasons. First, the SFF may decrease postoperative CSF leaks. Second, the SFF can retain the original anatomic structure and avoid an additional incision. Third, the SFF is a pedicled flap, and therefore, it may facilitate rapid healing. Fourth, the SFF can separate the pituitary gland from the sinonasal tract, which may protect the function of the pituitary gland.

### Conclusion

The SFF is a safe and noninvasive technique for universal sellar reconstruction and may decrease postoperative CSF leaks after endoscopic pituitary adenoma surgery.

### Author Contributions

**Zixiang Cong**, conception and design; data acquisition, analysis, and interpretation; drafting and revising of manuscript; final approval; **Kaidong Liu**, data acquisition, analysis, and interpretation; critically revising manuscript; final approval; **Guodao Wen**, data analysis and interpretation, critically revising manuscript, final approval; **Liang Qiao**, data analysis, critically revising manuscript; final approval; **Handong Wang**, conception, data acquisition, critically revising manuscript, final approval; **Chiyuan Ma**, conception and design, data acquisition, critically revising manuscript, final approval.

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### Supplemental Material

Additional supporting information is available in the online version of the article.

### References


