



Technical Notes

Sellar trough technique for endoscopic endonasal transclival repair

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ABSTRACT

Background: Endoscopic endonasal transclival approaches provide direct access to the ventral skull base allowing the treating of clival and paraclival pathology without the manipulation of the brain or neurovascular structures. Postoperative spinal fluid leak, however, remains a challenge and various techniques have been described to reconstruct the operative defect. The “gasket seal” has been well-described, but has anatomic challenges when applied to clival defects. We describe a modification of this technique for use in endonasal transclival approaches.

Methods: Two patients who underwent an endoscopic endonasal transclival approach for tumor resection with an intraoperative spinal fluid leak underwent a modified “gasket seal” closure technique for skull base reconstruction.

Results: A 71-year-old woman with a petroclival meningioma and a 22 year old with a clival chordoma underwent endoscopic endonasal transclival resection with the modified repair. No new postoperative deficits occurred and no postoperative spinal fluid leak was seen with a follow-up of 17 and 23 months, respectively.

Conclusion: We describe the successful use of a simple, low risk, and technique modification of the “gasket seal” technique adapted to the clivus that allows for hard reconstruction and facilitates placement of the nasoseptal flap.

Key words: Cerebrospinal fluid leak, Endoscopic endonasal approach, Endoscopic endonasal transclival, Skull base, Transclival

INTRODUCTION

The endonasal approach has increasingly moved beyond the sellar region. These expanded approaches can involve larger dural defects, high-flow cerebrospinal fluid (CSF) leaks, and local anatomy that can make dural repair and reconstruction challenging. The postoperative CSF leak rate in this setting has been reported to be as high as 30% when nonvascularized flap repair was used.^[12] However, the use and refinement of a vascularized nasoseptal flap have markedly reduced the CSF leak rate for expanded endonasal approaches to approximately 5%.^[8,12,17] Endoscopic transclival approaches remain challenging to repair and have the highest failure rate.^[15] Several closure techniques have been proposed that have utilized inlay or onlay material, vascularized or free tissue grafts, and various bolster techniques. Additional strategies include lumbar drains,^[2,4] fibrin sealants,^[5] balloon or sponge bolsters,^[4,6] and postoperative bed rest and measures to prevent transmission of intracranial pressure across the defect

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and healing reconstruction. Here, we report our modification of a previously described “gasket seal” closure technique adapting it to the unique anatomy of the clivus, utilizing a sellar trough, and porous polyethylene (PP) implant that allows for a simple, low risk, and hard reconstruction and facilitates nasoseptal flap repair.

METHODS

The charts of two patients who underwent an endoscopic endonasal transclival approach for tumor resection utilizing the modified “gasket seal” closure were reviewed and results reported. One patient was treated for a clival chordoma while the other for a petroclival meningioma.

Operative technique

The patient is placed supine on the operating table with the head on a gel donut headrest in mild extension and turned toward the operator. A two operator, four handed, and bi-nostral approach are employed. A nasal septal flap is elevated on the right and a submucosal, subperiosteal dissection for a transseptal approach is taken in the left nare. The sphenoid sinus is then opened widely and the ventral skull base closely inspected. The clival recess is skeletonized from paraclival carotid to paraclival carotid and from the sella to the inferior extent of the tumor. Once the tumor has been resected, attention is directed at closure. Using a high-speed drill and kerrison rongeur, a transverse trough along the ventral most aspect of the sella is prepared. A periumbilical fat graft obtained at the beginning of the surgery is sized appropriately and placed into the prepontine space extending through the clival defect with some mild extrusion into the sphenoid sinus. The PP implant (Medpor; Stryker; Kalamazoo, MI) is shaped and sized and advanced into the region of the defect. The inferior edge of the implant is seated into the caudal end of the clival defect that then acts as a fulcrum as the superior edge of the implant is advanced posteriorly until it snaps into the trough – the plate rests between the sellar dura and the sellar face [Figure 1]. The previously raised nasal septal flap is then placed over the implant. Lumbar drainage was not used.

RESULTS

Patient 1

A 71 year-old female with a right-sided petroclival meningioma presented with a right abducens nerve palsy. Near-total resection was achieved with residual tumor left adherent on the right abducens nerve. The modified “gasket seal” closure technique was used. The operative duration was 178 min. Hospital length of stay was 6 days. No postoperative CSF leak was noted with a follow-up of 17 months.

Patient 2

A 22-year-old male with incidentally found clival chordoma with noted growth and intradural invasion on follow-up imaging. This patient was without cranial nerve deficits before surgery. Gross total resection was achieved. An expected intraoperative CSF leak was observed. The modified “gasket seal” closure technique was used. The operative duration was 171 min. Hospital length of stay was 4 days. No postoperative CSF leak was noted with a follow up of 23 months [Figure 2 and Video 1].

DISCUSSION

The endoscopic endonasal approach to the clivus allows for access to the ventral skull base and the epicenter of these lesions without the need for brain retraction. Postoperative CSF leak is a known complication of endoscopic endonasal approaches with reported rates in transclival approaches as high as 25–35%.^[3,14,16]

Typical prevention strategies include CSF diversion through a lumbar drain, utilizing a multilayered closure, use of an

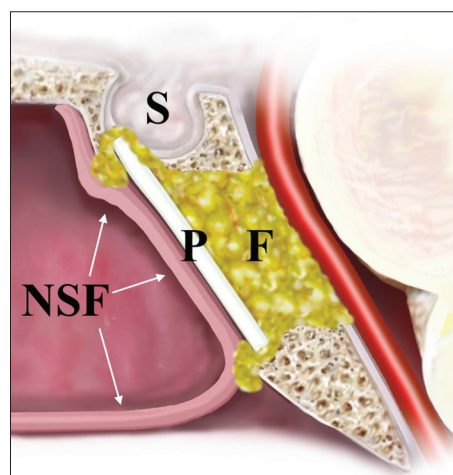


Figure 1: Sagittal view of the modified “gasket seal” technique. F: Autologous fat, P: Porous polyethylene plate, NSF: Nasoseptal flap; S: Sella.

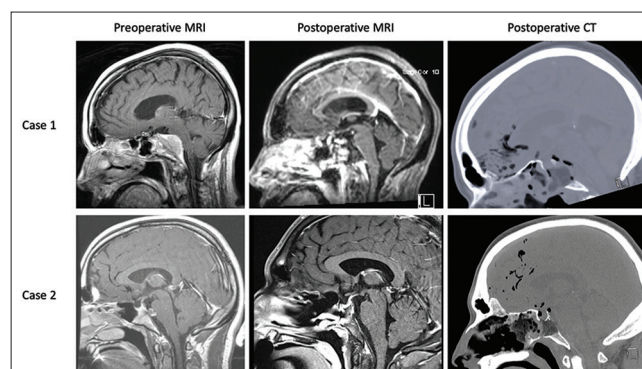


Figure 2: Preoperative and postoperative sagittal postcontrast magnetic resonance imaging. Postoperative sagittal computed tomography scan.

abdominal fat graft, and buttressing of the closure. Some have proposed primary dural closure, though the depth and dural condition generally make it technically challenging.^[1,9] Leng *et al.* described the “gasket seal” closure, which involved the placement of intradural autologous fat graft to eliminate dead space followed by an oversized piece of tissue, typically fascia lata, that is, countersunk with a hard reconstruction plate (porex, vomer, etc). The advantages of this technique are both watertight closure and hard reconstruction to counteract the pulsatile pressure of the spinal fluid. The original “gasket seal” description included only one clival case, but noted the limitation of the technique as requiring a rim of bone around the cranial base defect and if extensive bone removal is required (as in skeletonizing of the carotid), the technique may not be applicable.^[11] In a follow-up report, they described ten cases of transclival tumor resections with intraoperative spinal fluid leak repaired using the “gasket seal” technique. Nine out of the ten underwent successful closure without a postoperative spinal fluid leak. The authors noted the importance of maintaining a bone ledge to anchor the reconstruction plate and potentially using a Foley catheter for external bolster if no ledge is available.^[7]

The use of hard reconstruction has some potential concerns. When countersunk into the depth, in an immediate intradural or extradural location, the abducens nerve running along the petroclival fissure bilaterally can be placed at risk. When placed within the clival defect, depending on the degree of exposure, the paraclival carotids could be placed at risk. This has led some to avoid hard reconstruction in all transclival cases, instead of relying on nasal splints or Foley balloons. In a large retrospective study on multilayer closure with the use of a nasoseptal flap without hard reconstruction, there was a 13.6% of posterior fossa anatomic abnormalities including pontine encephaloceles.^[10] In that study, the effect of a hard reconstruction was approximated with Foley balloons and polyvinyl alcohol sponges. The use of autologous fat graft as a filler within the clival defect was found to reduce the risk on pontine encephalocele development. While not studied, it is possible that the addition of a hard reconstruction may reduce that risk.

One of the most significant advances in the endonasal skull base closure technique is the Hadad-Bassagastegy vascularized nasoseptal flap.^[8] Successful placement of the flap, however, requires contact with demucosalized sinus bone around the defect. For this reason, nasoseptal flap use after a transclival approach poses unique challenges. The depth of the clival defect needs to be traversed twice to reach from ipsilateral to the contralateral sphenoid sinus. The substantial length of nasoseptal flap required is not always available. Even proposed extended versions of the vascularized nasoseptal flap are not always sufficient to cover clival defects. In a cadaveric study, only 66–91% of nasoseptal flaps were sufficient, depending on the size of the defect.^[13]

Our modification of the “gasket seal” technique utilizes the effectiveness of the nasoseptal flap by eliminating the need for

a free fascial graft incorporated into the hard reconstruction. Since the initial description of the “gasket seal” predates the vascularized nasoseptal flap, it necessitated a fascial watertight layer in the technique. We use the autologous fat graft to achieve a watertight seal within the clival defect and still maintain a “gasket” effect at the superficial aspect of the fat graft by creating a slight overflow of fat into the sphenoid sinus cavity. This also allows tethering of the fat graft that prevents shifting or migration. We also translate the hard reconstruction to a more ventral location in-line with the sellar face. This obviates the risk to the abducens nerve and the paraclival arteries. We also tailor the width of the plate to be slightly less than the width of the defect, using only the upper sellar bone ledge and inferior clivus as a two-point anchor system. The absence of critical neurovascular structures superior and inferior allows a simple and safe rigid layer that acts as a bridge between the two sides of the clival recess. This adaptation also shortens the length of nasoseptal flap required as it eliminates the need for the flap to traverse the depth of the clival defect, thus making the likelihood of an insufficient flap size much lower [Figure 3].

While this report is limited by its number of cases, the purpose is to describe a technique that would theoretically provide a system of low-risk hard reconstruction while facilitating the use of a nasoseptal flap. More definitive assessment of the risks and benefits of this modification will require more experience. In addition, since the plate is held in place rostrally and caudally, a small amount of sellar face is required in addition to a portion of the inferior clivus.

The endoscopic endonasal transclival approach is an attractive option to surgically treating various clival and paraclival pathologies. Postoperative CSF leak remains a

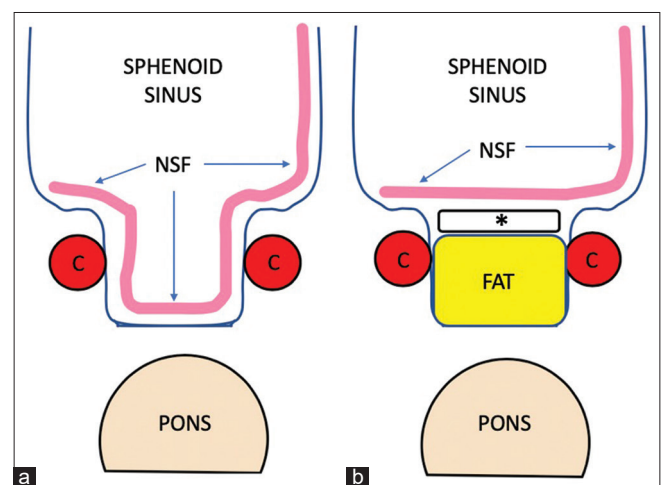


Figure 3: Schematic demonstrating the effect of the modified “gasket seal” technique on nasoseptal flap placement. (a) A normal “gasket seal” requires the flap to traverse the depth of the defect; (b) The modification allows the flap to lay flat across the hard reconstruction. NSF: Nasoseptal flap, C: Paraclival carotid.

significant risk despite the development of various closure methods. We describe the successful use of a simple, low risk, and technique modification of the “gasket seal” technique adapted to the clivus that allows for hard reconstruction and facilitates placement of the nasoseptal flap.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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