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Tools and techniques

# Sandwich technique using fibrin-coated collagen fleece for sellar reconstruction in large dural defects during transsphenoidal surgery

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ABSTRACT

*Purpose:* Various surgical methods to prevent intraoperative and postoperative cerebrospinal fluid (CSF) leaks during transsphenoidal approach (TSA) surgeries have been reported, but surgical techniques to address large dural defects have been less thoroughly investigated in the literature. The authors retrospectively evaluated the usefulness of the sandwich technique using fibrin-coated collagen fleece (TachoSil) to prevent intraoperative CSF leakage from large dural defects in TSA surgery.

*Methods:* In total, 101 cases of intraoperative CSF leaks were observed among 465 patients who underwent TSA surgery at a single university hospital between 2002 and 2014. Among them, cases with Grade 3 intraoperative CSF leakages and large diaphragmatic/dural defects were reconstructed via the sandwich technique using TachoSil or via the conventional technique using simple intrasellar packing with fat or synthetic materials, and these cases were enrolled in this study.

*Results:* A total of 28 cases with Grade 3 intraoperative CSF leakages were identified and analyzed. The sandwich technique using TachoSil was applied in 13 cases, and the conventional technique was applied in 15 cases. The postoperative CSF leakage was significantly decreased by the sandwich technique as compared to the conventional technique (retrospectively, 0 cases *vs.* 4 cases (30.8%); P = 0.044).

*Conclusion:* The sandwich technique using TachoSil can effectively prevent CSF leakage in cases with large dural defects during TSA surgery.



## 1. Introduction

The transsphenoidal approach (TSA) has been regarded as a safe and effective treatment for a variety of sellar and parasellar pathologies [1]. Although TSA had many advantages, cerebrospinal fluid (CSF) leaks are a well-known serious complication after TSA [2–7]. An intraoperative CSF leak occurs in up to 50% of pituitary tumor cases [8]. Several autologous and artificial grafts have been used to close the sellar floor in an attempt to prevent postoperative CSF rhinorrhea [6]. Avoidance of this complication usually involves the placement of an intrasellar and intrasphenoidal fat, fascial, or muscle graft with sellar floor reconstruction [2,8–10]. Closure of the sella turcica after TSA is alternatively accomplished with a nasoseptal flap [11–13], dural flap [14], free omental flap to the sphenoid sinus [15], mucoperichondrial nasal septal flap combined with a layered autologous tissue graft [16], dural suturing [14,17], absorbable gelatin foam and fibrin glue [18–21], a larger piece of collagen [22], gelatin foam [20], radiation-sterilized allografts of iliac bone and fascia lata from cadaver specimens [1], resorbable vicryl patches [20], artificial dura or fascia (Surgicel, Tissucol, Tissucol, BioGlue, TachoSil, or Alloderm) [9,23–27], or the AnastoClip vessel closure system [28]. Generally, an approach for repairing small weeping CSF leaks after transsphenoidal surgery is to use a collagen sponge with sellar floor reconstruction. In a previous study, the authors applied fibrin-coated collagen fleece (TachoSil, Nycomed, Linz, Austria) to prevent CSF leakage, and found that the sellar repair using TachoSil was effective to prevent CSF leakage after TSA surgery [29]. However, there have been no reports investigating intraoperative CSF leakage from large dural defects during transsphenoidal surgery. In this study, we retrospectively evaluated the safety and efficacy of the sandwich technique using TachoSil compared to the conventional technique using simple intrasellar packing with fat or synthetic material to prevent CSF leakage from large dural defects after TSA.

## 2. Materials and methods

This study was approved by the Internal Review Board of Severance Hospital, Yonsei University College of Medicine. Between

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2002 and 2014, a total of 472 patients with pituitary tumors of Hardy grades I to III and thirteen patients with chordomas in the upper clivus underwent TSA surgery at our institution. Among them, 171 cases of intraoperative CSF leaks were observed, and the dural closures were accomplished using autologous fat grafts and fibrin glue or the TachoSil application technique. The operative notes and other medical records of the cases with intraoperative CSF leaks were reviewed to identify the dural defect sizes during TSA surgery. Intraoperative CSF leaks were classified as Grade 0, absence of CSF leak, as confirmed by Valsalva maneuver; Grade 1, small "weeping" leak, as confirmed by Valsalva maneuver, without obvious or with only a small diaphragmatic defect; Grade 2, moderate CSF leak with obvious diaphragmatic defect; or Grade 3, large CSF leak, typically created as part of an extended transsphenoidal approach through the supradiaphragmatic or clival dura for tumor access [13]. The cases with a lack of medical information sufficient to define the CSF leak grade were excluded from this study.

Each patient underwent an endonasal TSA performed using an operating microscope. The bony keel of the sphenoid was removed bilaterally as it was progressively exposed. A custom-made Hardy speculum was passed through the nostril up to the face of the sphenoid. Wide removal of the sellar floor was followed by creation of a low curvilinear dural opening. This opening was typically extended bilaterally in a cephalad direction or in a cruciate fashion as tumor removal progressed. Dura with obvious tumor invasion was removed; however, in most instances, a large dural window was not removed. Tumor removal proceeded in the standard fashion using micro-ring curettes. After tumor removal was completed, the sellar cavity was explored for evidence of a CSF fistula, the presence of which was easily determined in most cases. One or two Valsalva maneuvers were performed to confirm the presence of a leak. In the instance of a small CSF leak without evidence of a large arachnoidal defect, only a small piece of TachoSil was applied to the arachnoidal defect. In some instances, the resection of suprasellar extended tumors resulted in the detachment of the normal pituitary gland margin from the dural edge, tearing the anterior superior arachnoid membrane. In this situation, in the conventional packing group, simple intrasellar packing with fat or synthetic material may have pushed the normal gland posteriorly, enlarging the gap between the normal gland margin and the dural edge, and increasing the chance of CSF leakage. Thus, a complete seal between the dural margin and the normal pituitary gland was critical to prevent this. In group that underwent the sandwich technique using TachoSil, the dried fleece was cut to size, then moistened and applied over the exposed diaphragma sellae and residual normal pituitary gland in the cephalad direction. The other TachoSil patches were prepared in the same fashion and placed bilaterally in the caudal direction like a 'sandwich'. The sellar cavity dead space was filled with fibrin glue (Greenplast, Green Cross P.D. Company, Yongin, Korea). A final TachoSil patch covered the entire sellar face in a single layer. A schematic drawing of the TachoSil repair with sellar floor reconstruction is shown in Fig. 1. The bony defect of the cranial base was reconstructed with a porous polyethylene implant (Medpor; Portex Surgical, Newnan, GA, USA). Neither sphenoid packing nor postoperative lumbar CSF drainage was performed in any patient. Nasal packing was removed within 2 days of surgery.

The Statistical Package for the Social Sciences version 22 (SPSS, Chicago, IL, USA) was used to calculate Student's *t*-test, the Mann-Whitney *U* test, and the chi-squared test. A p value less than 0.05 was considered significant.

## 3. Results

This retrospective study reviewed a database including 312 consecutive patients. Intraoperative CSF leaks were observed in 171 patients (54.8%), and all cases were managed by the sandwich technique using TachoSil or by the conventional technique. Among these, there were 59 cases (34.5%) with Grade 1 CSF leaks, 49 cases (28.7%) with Grade 2 CSF leaks, 45 cases (26.3%) with Grade 3 CSF leaks, and 18 cases (10.5%) with no available data. The cases with a Grade 3 intraoperative CSF leak were enrolled to compare the safety and effectiveness of the sandwich technique using TachoSil versus the conventional technique. The demographic and clinical characteristics of the cases with Grade 3 CSF leaks are shown in Table 1. There were no statistically significant differences between the groups with respect to age, sex, functioning or non-functioning adenomas, or modified Hardy classification.

All patients tolerated the procedure well. The sandwich technique using TachoSil to manage Grade 3 intraoperative CSF leaks was applied in 19 patients, and conventional packing management was applied in 28 patients. In the sandwich technique application

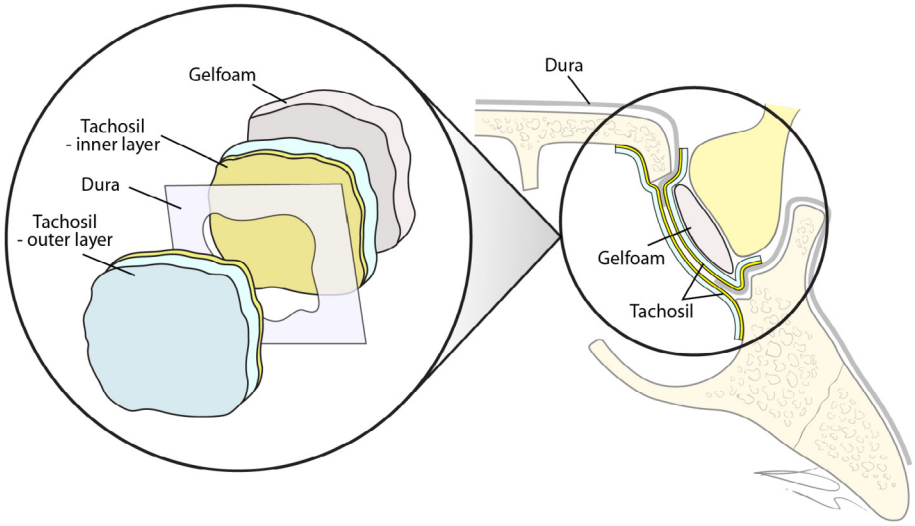


**Fig. 1.** Drawing of the sellar floor, depicting TachoSil repair with sellar floor reinforcement. The first TachoSil sheet was applied over the exposed diaphragm sella and residual normal pituitary gland in the cephalad direction, and the other TachoSil patches were placed bilaterally in the caudal direction. The sellar cavity dead space was filled with fibrin glue. The final patch covered the entire sellar face in a single layer.