



Original Article

Reducing CSF Leak After Infratentorial Surgeries: Role of Surgical Technique, Sealants, and Nutritional Optimization-An Institute Based Experience

Debabrata Deb¹, Prabhakar Narayan², Shreya Ashtosh Raina³, Mrinal Bhuyan⁴

¹Dept. of Neurosurgery, Gauhati Medical College and Hospital, Guwahati, India

²Dept. of Neurosurgery, Gauhati Medical College and Hospital, Guwahati, India

³Dept. of Neurosurgery, Gauhati Medical College and Hospital, Guwahati, India

⁴Dept. of Neurosurgery, Gauhati Medical College and Hospital, Guwahati, India

 OPEN ACCESS

Corresponding Author:

Prabhakar Narayan

Dept. of Neurosurgery, Gauhati
Medical College and Hospital,
Guwahati, India

Received: 15-04-2026

Accepted: 05-05-2026

Available online: 23-05-2026

Copyright© International Journal of
Medical and Pharmaceutical Research

ABSTRACT

Infratentorial surgeries are crucial in neurosurgery due to the high density of critical structures within the posterior fossa, prompting the development of various surgical approaches to ensure safe access.^{1,2} One of the most challenging complications following these procedures is cerebrospinal fluid (CSF) leakage, which is linked to delayed wound healing, meningitis, infections, pneumocephalus, and increased healthcare costs.³⁻⁵ Achieving a watertight dural closure is difficult due to the biomechanical properties of the dura mater, which is prone to shrinkage and fragility during prolonged surgeries.³⁻⁵ The incidence of CSF leak after cranial surgery ranges from 1% to 14%,^{6,7} and can reach up to 22% after infratentorial procedures despite advancements in surgical techniques and biomaterials.⁸⁻¹⁰ This study aims to evaluate the factors influencing CSF leak following various infratentorial approaches, to better inform perioperative strategies and patient counseling.

Keywords: Cerebrospinal Fluid Leak, Infratentorial Surgery, Posterior Fossa Approaches, Dural Closure, Neurosurgical Complications.

INTRODUCTION

Infratentorial surgeries are crucial in neurosurgery due to the high density of critical structures within the posterior fossa, prompting the development of various surgical approaches to ensure safe access.^{1,2} One of the most challenging complications following these procedures is cerebrospinal fluid (CSF) leakage, which is linked to delayed wound healing, meningitis, infections, pneumocephalus, and increased healthcare costs.³⁻⁵ Achieving a watertight dural closure is difficult due to the biomechanical properties of the dura mater, which is prone to shrinkage and fragility during prolonged surgeries.³⁻⁵ The incidence of CSF leak after cranial surgery ranges from 1% to 14%,^{6,7} and can reach up to 22% after infratentorial procedures despite advancements in surgical techniques and biomaterials.⁸⁻¹⁰

This study aims to evaluate the factors influencing CSF leak following various infratentorial approaches, to better inform perioperative strategies and patient counseling.

MATERIALS AND METHODS

A prospective observational study was conducted in the Department of Neurosurgery at the Gauhati medical college and hospital, Guwahati between January 1, 2025, and December 31, 2025. Data were collected using a semi-structured questionnaire. Comprehensive medical histories, including comorbidities, were obtained through patient interviews. Preoperative blood test results were recorded, and intraoperative variables were documented on the day of surgery by

theoperating room (OR) team. Postoperative follow-up was carried out for 30 days to monitor for CSF leaks and other postoperative variables.

All patients undergoing elective infratentorial cranial surgery during the study period were included. A total of 88 cases were analyzed

Variables

The dependent variable in this study was the occurrence of postoperative cerebrospinal fluid (CSF) leak. Independent variables included demographic, clinical, and surgical factors: gender, age, diabetes, hypertension, underlying pathology, location of pathology, presence of hydrocephalus, location of craniotomy, duration of surgery, intraoperative blood loss, type of procedure, use of a dural patch, dural closure technique (continuous vs. interrupted), use of ventriculoperitoneal shunt (VPS), placement of an lumbar drain, postoperative central nervous system (CNS) infection, length of postoperative hospital stay, and mortality.

Hydrocephalus was defined as radiologically diagnosed ventriculomegaly, indicated by an Evan's ratio > 0.3 , secondary to the underlying pathology. A CSF leak was defined as either visible leakage of CSF through the surgical wound (wound leakage) or the presence of a pseudomeningocele on physical examination, as confirmed by a neurosurgeon or neurosurgical resident.

Statistical Analysis

Data were coded, cleaned, entered, and analyzed using SPSS (Statistical Package for Social Studies) version 23. Descriptive data analysis like frequency and percentages were calculated for all variables. Cross-tabulations performed to determine the relationship between independent variables and CSF leak. Results were presented using tables. Correlation analysis was performed to assess the association between the studied variables. Independent variables that showed a significant correlation with the dependent variable were further analyzed to identify predictors of postoperative CSF leaks.

RESULTS

Table 1: Demographic distribution of infratentorial tumours.

Age in years	Number	Percentage
<10	4	4.54
10-20	16	18.18
21-30	5	5.68
31-40	21	23.86
41-50	26	29.54
51-60	15	17.04
>60	1	1.13
Sex	Number	
Male	73	
Female	15	
Nature of Tumour	Number	Percentage
VII thSchwanoma	23	26.13
CP Angle Epidermoid	13	14.77
Vth Schwanoma	10	11.36
CP Angle Meningioma	8	9.09
Tentorial Meningioma	4	4.54
Posterior Fossa Epidermoid	2	2.27
Pilocytic Astrocytoma	9	10.22
Hemangioblastoma	5	5.68
Medulloblastoma	5	5.68
Ependymoma	7	7.94

Table 1 Shows that the age distribution among patients with most common age distribution between 41-50 years of age and mean age being 36.01 years, Male:Female ratio 4.86, most common tumour operated being VIIthSchwanoma with 26.13% Pateints.

Table 2 Surgical Procedure Performed

Procedure	Number	Percentage
Midline Suboccipital Craniotomy	18	20.45
Midline Suboccipital Craniectomy	13	14.77

Retromastoid Craniotomy	Suboccipital	34	38.63
Retromastoid Craniectomy	Suboccipital	23	26.13

Table 2 Showing the most common Surgical Procedure performed being Retromastoid Suboccipital Craniotomy in 34 patients with 38.63% cases.

Table 3 Complications

Complications	Number	Percentage
Pseudomeningocele	13	76.47
Incisional CSF Leak	7	41.17
Post Surgery Hydrocephalus	6	35.29
Meningitis	4	23.52
Total	17	19.31

Table 3 Showing the distribution of complications with total 17 patients had complications (one patient may have more than one complication) with 19.31% cases out of 88 operated cases. Out of which Pseudomeningocele was the most common complication in 13 out of 17 cases with 76.47%.

Table 4 Management Of Complications

Procedure	Number	Percentage
Dressing	7	41.11
Lumbar Drain Insertion	6	35.31
Post Surgery VP Shunt	3	17.61
Reexploration and repair	1	5.88

Table 4 Showing that out 17 cases, 7 cases underwent dressing and spontaneous resolution of csf leak, Lumbar drain was inserted in 6 (35.31%) cases, Post Surgery VP Shunt was done in 3 (17.61%) cases and 1 case underwent reexploration and repair and in that cases composition of Sealer protein solution and Fibrin sealant commercially known as Tisseel Glue was used.

Table 5 Use of Glue

Glue	Number	CSF Leak
Not Used	71	14
Used	17	3

Table 5 Showing that out of 17 cases where Glue was used during Surgery 3 (17.64%) cases had CSF leak and in 71 Cases where glue was not used 14 (82.36%) cases had leak

Table 6 Showing Distribution of Comorbiddities

Parameter	Number	Percentage
Diabetieus Mellitus	7	7.95
Hypertension	8	9.09
Both	1	1.13
S.albumin<2.5 g/dl	Number	CSF Leak
No	81	No
Yes	7	Yes

Table 6 Showing 7 out of 88 cases had Serum Albumin level less than 2.5g/dl and all 7 cases had Csf leak, 7 Cases had Diabetiues and 8 Cases had Hypertension and out of 7 cases of Diabeties 3 cases had CSF leak.

Table 7 Distribution among procedure performed and Csf Leak

Procedure	Number	Percentage
Midline Suboccipital Craniotomy	1	5.88
Midline Suboccipital Craniectomy	6	35.29
Retromastoid Craniotomy	3	17.64
Retromastoid Craniectomy	7	41.17

Table 7 Showing the relationship between procedure performed and Csf leak with RMSO Craniectomy had 7 (41.17%) cases of leak followed by Midline Suboccipital Craniectomy 6 (35.29%) cases .

Table 8HPE of Tumour and Csf Leak

Tumour	Number	Percentage
VII thSchwanoma	9	52.94
CP angle Epidermoid	1	5.88
Ependymoma	4	23.53
Pilocytic Astrocytoma	3	17.64

Table 8 Showing that VII thSchwanoma had been the most common tumor to be associated with leak in 9 (52.94%) cases followed by Ependymoma in 4 (23.53%) cases.

The mean hospital stay was 12.8 days

The mean ICU stay was 9.3 days .6 patients were postoperatively shifted to ICU.

Morbidity ratio was 0.19. and percentage being 19.31%

DISCUSSION

In terms of our primary outcome, the postoperative CSF leak rate differed significantly between the craniotomy and craniectomy groups. Among all 17 cases of CSF leak, the craniectomy group exhibited nearly three times the incidence compared to the craniotomy group (76% vs. 24%). This finding aligns with the meta-analysis by Alhantoobi et al., who reported a CSF leak incidence of 11.00% in the craniectomy group versus 5.79% in the craniotomy group.¹¹ Similarly, other studies have consistently demonstrated an increased risk of CSF leakage following craniectomy compared to craniotomy.¹⁷⁻¹⁹ One possible explanation is that replacing the bone flap between the dura and overlying muscle in craniotomy may prevent adhesion and traction between these layers, reducing the risk of dural tearing.¹⁷

Although factors such as age, sex, and the presence of pre- or postoperative hydrocephalus have previously been associated with CSF leak,¹²⁻¹⁵ these variables did not show significant correlation with leak incidence in our cohort. In contrast, the type of pathology operated did correlate with increased risk, with vestibular schwannomas being most frequently associated with CSF leaks. This is consistent with literature reporting increased risk due to the need for drilling of the petrous bone of the internal auditory canal during gross total resection of such tumors.^{15, 16}

The use of Tisseel glue was also significantly associated with a reduced risk of CSF leak. Among the 3 patients who received Tisseel, only 17.64% experienced CSF leak, compared to 82.36% among the 14 cases with leaks in the 71 patients who did not receive the glue. This suggests a protective effect of fibrin sealant in achieving watertight dural closure.²⁰

Additionally, preoperative serum albumin levels below 2.5 g/dL were associated with an increased risk of postoperative CSF leak, likely due to impaired wound healing capacity. This finding emphasizes the importance of considering nutritional status as a modifiable risk factor often overlooked in neurosurgical practice.

In terms of management, most CSF leaks (41.11%) resolved spontaneously with conservative measures such as compression dressing and acetazolamide administration. Despite the variation in mechanisms underlying CSF leakage, prompt recognition and management remain critical to prevent severe complications such as life-threatening meningitis.

CONCLUSION

In our study, we identified specific patient subgroups at increased risk for CSF leak following the retrosigmoid approach for various posterior fossa pathologies. Notably, the routine use of Tisseel glue and preoperative optimization of serum albumin levels emerged as important considerations in reducing postoperative CSF leakage. Our findings also demonstrated a clear advantage of craniotomies over craniectomies in minimizing the incidence of CSF leak and pseudomeningocele formation.

Given the absence of evidence suggesting higher surgical risk with infratentorial craniotomies, neurosurgeons may consider favoring this approach when feasible. However, further prospectivestudies are warranted to validate the protective role of craniotomy in reducing postoperative CSF-related complications in posterior fossa surgeries.

REFERENCES

1. Dubey A, Sung WS, Shaya M, Patwardhan R, Willis B, Smith D, *et al.* Complications of posterior cranial fossa surgery-an institutional experience of 500 patients. *SurgNeurol*2009;72:369-75.

2. Beer-Furlan A, Vellutini EA, Gomes MQ, Cardoso AC, Prevedello LM, Todeschini AB, *et al.* Approach selection and surgical planning in posterior cranial fossa Meningiomas: How I do it. *J NeurolSurg B Skull Base* 2019;80:380-91.
3. J.A. Grotenhuis, Costs of postoperative cerebrospinal fluid leakage: 1-Year, retrospective analysis of 412 consecutive nontrauma cases, *Surg Neurol.* 64 (6) (2005) 490–493.
4. M. Barth, J. Tuettenberg, C. Thom´e, C. Weiss, P. Vajkoczy, P. Schmiedek, Watertight dural closure: Is it necessary? A prospective randomized trial in patients with supratentorial craniotomies, *Neurosurgery* 63 (4 SUPPL.) (2008) 352–358.
5. Kinaci A, Algra A, Heuts S, O'Donnell D, van der Zwan A, van Doormaal T. Effectiveness of Dural Sealants in Prevention of Cerebrospinal Fluid Leakage After Craniotomy: A Systematic Review. *World Neurosurg* [Internet]. 2018;118:368- 376.e1. Available from: 10.1016/j.wneu.2018.06.196.
6. J.W. Brennan, D.W. Rowed, J.M. Nedzelski, J.M. Chen, Cerebrospinal fluid leak after acoustic neuroma surgery: Influence of tumor size and surgical approach on incidence and response to treatment, *J Neurosurg.* 94 (2) (2001) 217–223.
7. A. Ali, D. Saha, Incidence of complications following non-watertight dural reconstruction with a non-suturable, absorbable collagen matrix onlay graft in elective cranial surgery, *Int Surg J.* 7 (7) (2020) 2316
8. Cueva RA, Mastrodimos B. Approach design and closure techniques to minimize cerebrospinal fluid leak after cerebellopontine angle tumor surgery. *OtolNeurotol*2005;26:1176-81.
9. Dandy WE. Removal of cerebellopontine (acoustic) tumors through a unilateral approach. *Arch Surg*1934;29:337-44.
10. Ling PY, Mendelson ZS, Reddy RK, Jyung RW, Liu JK. Reconstruction after retrosigmoid approaches using autologous at graft-assisted Medpor Titan cranioplasty: Assessment of postoperative cerebrospinal fluid leaks and headaches in 60 cases. *Acta Neurochir (Wien)* 2014;156:1879-88.
11. Alhantoobi MR, Kesserwan MA, Khayat HA, Lawasi M, Sharma S. Rates of cerebrospinal fluid leak and pseudomeningocele formation after posterior fossa craniotomy versus craniectomy: A systematic review and meta-analysis. *SurgNeurol Int*2023;14:140.
12. Brennan JW, Rowed DW, Nedzelski JM, Chen JM. Cerebrospinal fluid leak after acoustic neuroma surgery: Influence of tumor size and surgical approach on incidence and response to treatment. *J Neurosurg*2001;94:217-23.
13. Bryce GE, Nedzelski JM, Rowed DW, Rappaport JM. Cerebrospinal fluid leaks and meningitis in acoustic neuroma surgery. *Otolaryngol Head Neck Surg*1991;104:81-7.
14. Copeland WR, Mallory GW, Neff BA, Driscoll CL, Link MJ. Are there modifiable risk factors to prevent a cerebrospinal fluid leak following vestibular schwannoma surgery? *J Neurosurg*2015;122:312-6.
15. Stieglitz LH, Wrede KH, Gharabaghi A, Gerganov VM, Samii A, Samii M, *et al.* Factors affecting postoperative cerebrospinal fluid leaks after retrosigmoidal craniotomy for vestibular schwannomas. *J Neurosurg*2009;111:874-83.
16. Shew M, Muelleman T, Harris M, Li M, Sykes K, Staecker H, *et al.* Petrous apex pneumatization: Influence on postoperative cerebellopontine angle tumor cerebrospinal fluid fistula. *Ann Otol RhinolLaryngol*2018;127:604-7.
17. Della Pepa GM, Montano N, Lucantoni C, Alexandre AM, Papacci F, Meglio M. Craniotomy repair with the retrosigmoid approach: The impact on quality of life of meticulous reconstruction of anatomical layers. *Acta Neurochir (Wien)* 2011;153:2255-8.
18. Legnani FG, Saladino A, Casali C, Vetrano IG, Varisco M, Mattei L, *et al.* Craniotomy vs. craniectomy for posterior fossa tumors: A prospective study to evaluate complications after surgery. *Acta Neurochir (Wien)* 2013;155:2281-6
19. Teo MK, Eljamel MS. Role of craniotomy repair in reducing postoperative headaches after a retrosigmoid approach. *Neurosurgery* 2010;67:1286-91.
20. Kassam A, Horowitz M, Carrau R, Snyderman C, Welch W, Hirsch B, Chang YF. Use of Tisseel fibrin sealant in neurosurgical procedures: incidence of cerebrospinal fluid leaks and cost-benefit analysis in a retrospective study. *Neurosurgery.* 2003 May;52(5):1102-5; discussion 1105. PMID: 12699553.