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Original Research Article

Redo Operation for Cerebrospinal Fluid (CSF) Leak After Spine Surgery

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Abstract: *Cerebrospinal fluid (CSF) leak is a recognized complication following spine surgery and may result in the need for a secondary or "redo" operation. Early identification and effective management of such leaks are essential to prevent morbidity and optimize recovery. However, local data on the frequency and predictors of redo operations for CSF leaks in Pakistan remain scarce.* ***Objective:*** *To determine the frequency of redo operations for CSF leaks following spine surgery among patients admitted at The Aga Khan University Hospital, Karachi.* ***Methods:*** *This descriptive cross-sectional study was conducted at The Aga Khan University Hospital, Karachi, from July 7, 2024, to January 7, 2025. Ethical approval was obtained from the institutional review board. A total of 50 patients aged 18 to 80 years, of either gender, classified as ASA I–III, who developed a CSF leak within three months of spine surgery, were enrolled through non-probability consecutive sampling. Patient records were reviewed for postoperative complications, including CSF leak, swelling, wound dehiscence, and surgical site infection. The primary outcome was the frequency of redo operations for CSF leak. Data were analyzed using SPSS version 26, and a chi-square test was applied to assess associations, with $p < 0.05$ considered statistically significant.* ***Results:*** *Of the 50 patients, 27 (54%) had no postoperative complications. CSF leak with swelling occurred in 3 patients (6%), CSF leak alone in 5 (10%), and swelling alone in 3 (6%). Wound dehiscence was seen in 8 patients (16%), and surgical site infection in 5 (10%). Redo operations were required in 16 patients (32%). At the three-month follow-up, all wounds had healed, except for one patient who had residual swelling. Redo surgery was not significantly associated with age ($p = 0.827$), gender ($p = 0.658$), or spinal level involved ($p = 0.116$), although lumbar involvement accounted for the highest number of cases ($n = 8$).* ***Conclusion:*** *The findings demonstrate a considerable frequency of postoperative complications and redo surgeries among patients experiencing CSF leak after spine surgery. These results underscore the importance of refined surgical techniques, heightened intraoperative vigilance, and rigorous postoperative follow-up to reduce the incidence and enhance patient outcomes.*

Keywords: Cerebrospinal Fluid Leak, Lumbar Vertebrae, Postoperative Complications, Reoperation, Spine Surgery, Surgical Site Infection

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Introduction

The occurrence of cerebrospinal fluid (CSF) leaks remains a well-recognized problem after spinal surgery, affecting up to 16% of patients. Postoperative CSF leakages result in serious health complications because they increase the threat of meningitis, together with arachnoiditis and delayed wound healing (1). Many CSF leaks are detected during the first surgery, but some cases persist after the operation, requiring further medical intervention. Redo procedures become necessary after both unsuccessful first-time repairs and leaks that appear during the post-procedure healing period (2).

Postoperative CSF leak management encompasses two key elements: careful surgical surveillance and meticulous surgical closure techniques. The surgical prevention strategy employs meticulous surgical procedures and a thorough preoperative assessment of patient risks (3). It is vital to handle the dura mater cautiously, along with preventing any leftover bone spikes from surgery, since both factors increase the risk of puncturing the dural sac. Surgeons should begin their surgical work on tissue areas unmarked by scars when revising previous procedures to reduce potential complications (4).

The detection of CSF leaks during surgery leads to standard practices of direct suture repair methods. The surgical repair succeeds in 91% to 95% of cases. Dural substitutes and autologous grafts, including fat and muscle, together with fascia, can be incorporated to boost the efficacy of dural repair. Autologous fat grafts achieve a watertight closure in addition to restoring blood supply while minimizing scarring (5).

Post-operative mobilization is another factor that needs to be considered and is mostly dependent on the surgeon's preference. However, if intraoperative repair is adequate with no leak seen on the Valsalva maneuver, most patients are mobilized on the first postoperative day with no repercussions. However, some surgeons still prefer delayed mobilization to prevent post-operative leaks.

Despite the above preventive measures, some patients may still present with CSF leaks during the post-operative period. One option to deal with these patients is the insertion of a subarachnoid drain (lumbar drain), a procedure mostly done at the bedside under local anesthesia. The drain is kept in situ for approximately 4-5 days, providing a CSF diversion mechanism, while the wound is regularly observed for leakage. In the majority of patients, this is sufficient, and leaks are successfully managed non-operatively.

A small number of patients need redo operations because their CSF leaks persist or recur despite the treatment measures. Successful secondary repairs are of critical importance because unfulfilled repairs lead patients to face an elevated risk of impaired wound healing and infections, as well as prolonged inpatient hospitalization (6).

The success of redo operations for CSF leaks following spinal surgery requires strict surgical techniques and suitable repair materials, along with postoperative monitoring. Future research should focus on advancing surgical methods, as this will help minimize the occurrence of recurrent CSF leaks and improve patient outcomes. The objective of this study is to determine the frequency of redo operations for CSF leaks after spine surgery among patients admitted to The Aga Khan University Hospital, Karachi.

Methodology

Following institutional review board approval, this descriptive cross-sectional study was conducted at The Aga Khan University Hospital, Karachi, from July 7, 2024, to January 7, 2025. Through non-probability consecutive sampling, 50 patients aged 18-80 years, of both genders, with ASA I-III classification, and with a CSF leak occurring anytime within 3 months of initial spine surgery, were included in the present study. Patients with spinal fractures after trauma, with COPD, or chronic constipation, with concurrent spinal infections, may complicate the assessment of CSF leaks, and outcomes were excluded from the present study. After the informed consent, baseline data, encompassing demographic information like age, gender, height, weight, current smoker, history of diabetes mellitus, hypertension, cardiovascular diseases (confirmed by patient medical records) and clinical characteristics like headache, nausea, vomiting, reason of spine surgery, previous spine surgery, on steroid therapy, on anticoagulation therapy or antiplatelet therapy, procedure performed, region involved, discharge destination, complications was recorded for each participant. Height was measured using a wall-mounted scale in meters, without shoes and a cap. Weight was assessed on an electronic scale in Kg without shoes and in a hospital gown. Body mass Index (BMI) was calculated by dividing the weight in kilograms by the height in meters squared. A CSF leak was diagnosed based on clinical findings and imaging. All patients received standard conservative management for the CSF leak, including bed rest, dressing, wound re-suturing, and antibiotics. Subsequent follow-up assessments were conducted to monitor responses to conservative management. The final evaluation was performed 3 months post-surgery. Patients requiring redo operations due to persistent or recurrent CSF leak issues were identified. SPSS version 24 was used for statistical analysis. The mean and standard deviation were calculated for quantitative variables, including age, weight, height, body mass index (BMI), duration of spine surgery, duration of hospital stay, and amount of blood loss. Frequency and percentages was calculated for gender, ASA, current smoker (a person who smoked more 100 cigarettes in his life time and smoked in the last month as well), reason of spine surgery, previous spine surgery, on steroid therapy, on anticoagulation therapy or antiplatelet therapy, procedure performed, region involved, discharge destination, complications (surgical site infection, wound dehiscence assessed on clinical examination) and requirement of re-do operation. Comparison was made to examine the association between demographic and clinical characteristics and redo operations. Chi-square test/Fisher-Exact test was applied. The p-value of ≤ 0.05 was considered significant.

Results

The study included 50 patients with a mean age of 50.76 ± 14.6 years. Among them, 29 (58%) were male, and 21 (42%) were female. The mean weight and height of the patients were 77.3 ± 15.3 kg and 162.1 ± 10.3 cm, respectively, with an average BMI of 29.5 ± 6.1 kg/m². Based on the American Society of Anesthesiologists (ASA) classification, most patients (62%) were classified as ASA II, while 22% were classified as ASA III, and 8% were classified as ASA I. Only 4% of the patients were current smokers (Table 1).

The primary reasons for spine surgery were spinal stenosis (19 cases), degenerative disc disease (14 cases), stenosis with listhesis (5 cases), degenerative disc with stenosis (3 cases), vertebral fracture (2 cases), synovial cyst (2 cases), tumor (2 cases), and stenosis with abscess (1 case) (Figure 1).

Regarding pre- and post-operative variables, five patients had undergone previous spine surgery (10%). A total of 5 patients (10%) were on steroids, and 2 (4%) were on antiplatelet or anticoagulant therapy. The distribution of the spinal region involved in surgery showed that 66% of cases were lumbar, 13% were lumbosacral, and 8% were cervical. The average duration of surgery was 185.7 ± 133.3 minutes, with a mean blood loss of 221.4 ± 456.3 ml. The average length of hospital stay (LOS) was 4.8 ± 4.1 days. Postoperatively, 27 patients (54%) had no complications, while 3 (6%) had CSF leak with swelling, 5 (10%) had CSF leak alone, and 3 (6%) experienced swelling alone. Impaired wound healing was observed in 8 patients (16%), whereas 5 (10%) developed surgical site infections (SSI). Notably, 16 patients (32%) required a redo operation. At the three-month follow-up, only one patient had swelling (2%); the remaining patients' wounds had healed completely. (Table 2).

In terms of surgical procedures, the most common operation was laminectomy (22 cases), followed by discectomy (12 cases). Other methods included laminectomy with discectomy (2 cases), laminectomy with fusion (4 cases), interlaminar decompression (ILD) alone (1 case), ILD with fusion (1 case), ILD with discectomy (1 case), fusion alone (1 case), discectomy with fusion (1 case), and foraminotomy (1 case) (Figure 2).

Stratification of redo operations revealed no statistically significant difference based on age ($p = 0.827$) or gender ($p = 0.658$). Among those who underwent a redo operation, 10 were male and six were female. Patients with lumbar involvement had the highest number of redo surgeries (8 cases), followed by those with the lumbosacral participation (5 cases) and cervical involvement (3 cases); however, this difference was not statistically significant ($p = 0.116$) (Table 3).

Table 1: Demographic and Clinical Variables

Variables	Mean and Frequency (n=50)
Age (Years)	50.76±14.6
Gender	
Male	29 (58%)
Female	21 (42%)
Weight (kg)	77.3±15.3
Height (m)	162.1±10.3
BMI (kg/m^2)	29.5±6.1
ASA	
I	4 (8%)
II	31 (62%)
III	11 (22%)
Current smoker	2 (4%)

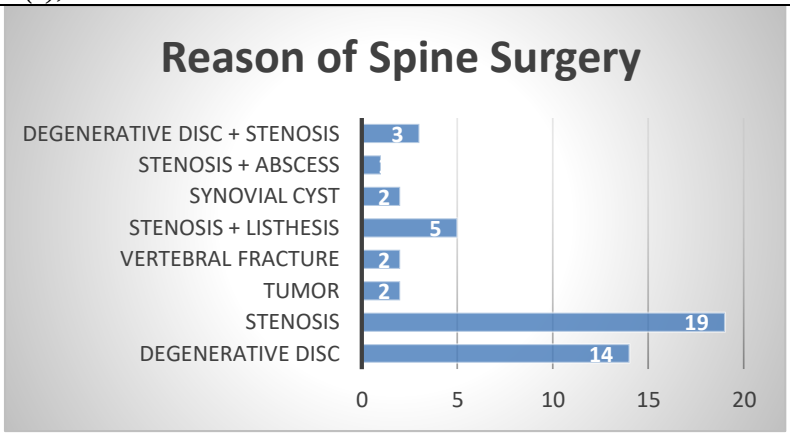

Figure 1: Different reasons for spine surgery in the study population

Table 2: Pre and Post-operative variables

Variables	**Mean and Frequency (n=50)**
Previous spine surgery	0
On steroid	5 (10%)
An antiplatelet/anticoagulant	2 (4%)
Region	
Lumbosacral	13 (13%)
Lumbar	33 (66%)
Cervical	4 (8%)
Duration of surgery (min)	185.7±133.3
Blood loss (mL)	221.4±456.3
LOS (days)	4.8±4.1
Complications	
None	27 (54%)
CSF leak + swelling	3 (6%)
CSF leak	5 (10%)
Swelling	3 (6%)
Impaired wound healing	8 (16%)
SSI	5 (10%)
Redo operation	16 (32%)
3 months post-op complication	
Impaired wound healing	46 (92%)
swelling	4 (8%)

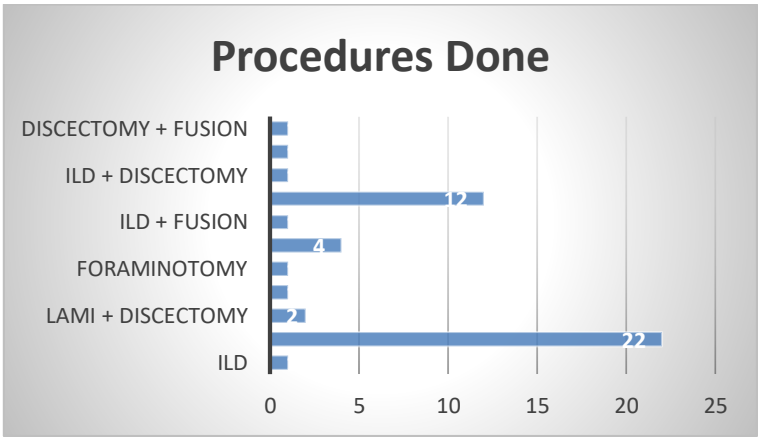

Figure 2: Frequency of different procedures

Table 3: Stratification by age gender and region

Variables	Redo Operations		P value
	Yes	No	
Age (Years)			0.827
<50	7	16	
>50	9	18	
Gender			0.658
Male	10	19	
Female	6	15	
Region			0.116
Lumbar	8	25	
Lumbosacral	5	8	
Cervical	3	4	

Discussion

The present cohort of 50 patients (mean age 50.8 ± 14.6 years; 58% male) mirrors the demographic profile seen in many contemporary spinal surgery series, where middle-aged adults with overweight or mild obesity (mean BMI 29.5 ± 6.1 kg/m²) predominate. (10, 11). The ASA distribution (62% ASA II, 22% ASA III) suggests a generally moderate comorbidity burden, consistent with elective decompression and fusion populations reported elsewhere (12). Our objective—to characterize the incidence, risk factors, and outcomes of redo operations for postoperative CSF leak—was therefore justified by the notable 32% re-operation rate observed, which exceeds the 5–15% re-intervention rates typically cited for dural tear repair failures (13)

Important to note is that spinal stenosis (38%) and degenerative disc disease (28%) were the leading surgical indications, in line with extensive registry studies that show these pathologies as the predominant drivers of spinal interventions (14). However, these series report CSF leak rates of 1 to 10% and reoperation rates of less than 10%, in contrast to our cohort having a 16% CSF leak rate and 32% redo rate, which may either reflect a higher risk case mix or gaps in the initial dural repair techniques (15). The mean operative time was 186 minutes, and blood loss was 221 mL, which were within broad norms; however, the overall complication rate was 46 percent, indicative of the complexity of cases that required reoperation. Prior literature has suggested that attention to meticulous intraoperative dural handling, as well as the use of sealants and multilayer closure, reduces leaks and reoperations (16). One recent randomized trial has shown that non-penetrating titanium clips reduce CSF leak recurrence from 12 to 3%, potentially leading to a reduction in our high re-operation rate by adopting such more advanced closure methods (17). In addition, 10% of our patients had high BMI and 10% used steroids, both of which were independently associated with increased leak risk and poor dural healing (18). Thus, preoperative nutritional and medical status could be optimised to reduce reoperation risk. In our study, stratification analysis revealed no statistically significant difference between redo operations and age, sex, or spinal segment ($p > 0.11$ for all). Some prior studies have reported older age and multilevel stenosis as risk factors [for dural tears and reoperation] (19), which may limit our sample size to detect such differences. However, the widespread distribution of redo cases on all lumbar, lumbosacral, and cervical regions suggests that risk is not confined to a single anatomical level. To summarize, these findings both support and exceed the complication rates reported in the literature, thereby justifying the study's objective to review redo operations for CSF leaks critically. These points suggest methods to improve dural closure techniques, perioperative optimization, and multicenter collaboration for developing standardized protocols that would lead to a decrease in the substantial reoperation burden.

Conclusion

Research findings align with previous studies that examine spinal surgery patient demographics, as well as surgical needs and operative complication statistics. The high number of repeat operations indicates that advancements in surgical methods, combined with improvements in postoperative care standards, must continue to achieve better patient outcomes. Studies should examine both preventive techniques and new surgical procedures to decrease the occurrence of complications and subsequent medical procedures.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned.
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AN (Resident)
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FN (Graduate)
Conception of Study, Development of Research Methodology Design,
AAL (Assistant Professor)
Study Design, manuscript review, critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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