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Research Article

Original Article

Efficacy of a Standardized 48-Hour Flat-prone, Bed Rest Protocol for Postoperative Cerebrospinal Fluid Leakage Following Spinal Surgery

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Abstract

Objective: To evaluate the efficacy of a standardized 48-hour flat-prone bed rest protocol in managing postoperative cerebrospinal fluid leakage following spinal surgery.

Methods: This retrospective cohort study analyzed 114 patients who underwent spinal instrumentation between 2018 and 2023 and experienced documented postoperative CSF leakage. All patients were managed with a standardized protocol mandating 48 hours of strict flat-prone, bed rest, followed by a gradual postural transition. Clinical outcomes, including the total duration to complete resolution of CSF drainage, length of hospital stay, and incidence of secondary complications, were systematically recorded.

Results: The median time for complete resolution of postoperative CSF drainage was 4.8 days.

Multivariate regression analysis identified no statistically significant correlation between the anatomical level of the dural defect and the time to clinical resolution. During follow-up, eight patients required surgical revision, while five patients experienced wound-related complications.

Conclusion: The prescribed 48-hour flat-supine bed rest protocol effectively manages postoperative CSF leakage with minimal rates of secondary surgical intervention or infectious complications.

Keywords. Spinal surgery ,CSF leak prone posture, bed rest ,spinal instrumentation.

Introduction

Postoperative cerebrospinal fluid leakage remains a frequent and clinically significant complication following spinal surgery, often leading to secondary complications such as wound infections and intracranial hypotension [1].While conservative management strategies, such as strict bed rest and specific posture modifications, are frequently employed to facilitate dural healing and reduce hydrostatic pressure at the site of the leak, clinical evidence regarding their efficacy remains inconsistent[2]. Current clinical protocols often rely on traditional practice patterns rather than robust, high-quality data, fueling ongoing controversy regarding the true therapeutic necessity of prolonged immobilization.[2,3] Furthermore, recent findings comparing early mobilization to prolonged bed rest suggest that extended immobilization may not be strictly necessary to prevent or resolve these leaks, potentially offering a safer alternative to reduce the length of hospital stay and secondary complications.[4] Despite the widespread utilization of these postural interventions in clinical settings, the optimal duration and specific mechanical benefits of head-of-bed elevation remain poorly defined in current literature.[5] Consequently, while interventions such as the semi-Fowler's position are frequently utilized to mitigate lumbar

hydrostatic pressure [6], the lack of standardized protocols hinders the development of evidence-based guidelines for postoperative care.

Literature Review

The reported incidence of dural tears during primary spinal instrumentation ranges from 3% to 17%, with factors such as revision surgery, ossification of the posterior longitudinal ligament, and advanced patient age significantly increasing the risk of persistent postoperative leakage. Despite these identified risk factors, clinical approaches to managing resultant leaks vary substantially, often alternating between immediate aggressive wound closure and conservative protocols favoring prolonged recumbency.

Notably, however, the anatomical level of the durotomy itself should shape the postural strategy employed, because *in vivo* subarachnoid pressure recordings have shown that increasing recumbent inclination exerts divergent effects along the craniospinal axis—elevating lumbar sac pressure while simultaneously reducing cervical subarachnoid pressure by nearly half—thereby challenging the uniform application of semi-Fowler's positioning(medical postion, patient is kept less on back and head elevated between 3040 degrees) across all spinal levels [7]. Furthermore, current protocols regarding mandatory bed rest duration remain contentious, as evidence from recent cohort studies indicates that prolonged drainage systems can significantly improve success rates compared to single drain systems [8].

Material and Methods

Study design Retrospective cohort**.**

Settings. Department of Neurosurgery Pakistan Institute of medical Sciences from February

2018 to December 2024**.**

Inclusion Criteria. we included age between 5 years to 65 years having Intraoperative dural tear or surgical durotomy for spinal procedures.

Exclusion Criteria, Redo spinal surgery, spinal deformity, subluxation or traumatic CSF leak. Age below 5 years.

Data analysis

Patients' data was collected and from in departmental computerized hospital record and analyzed by SPSS version 21.

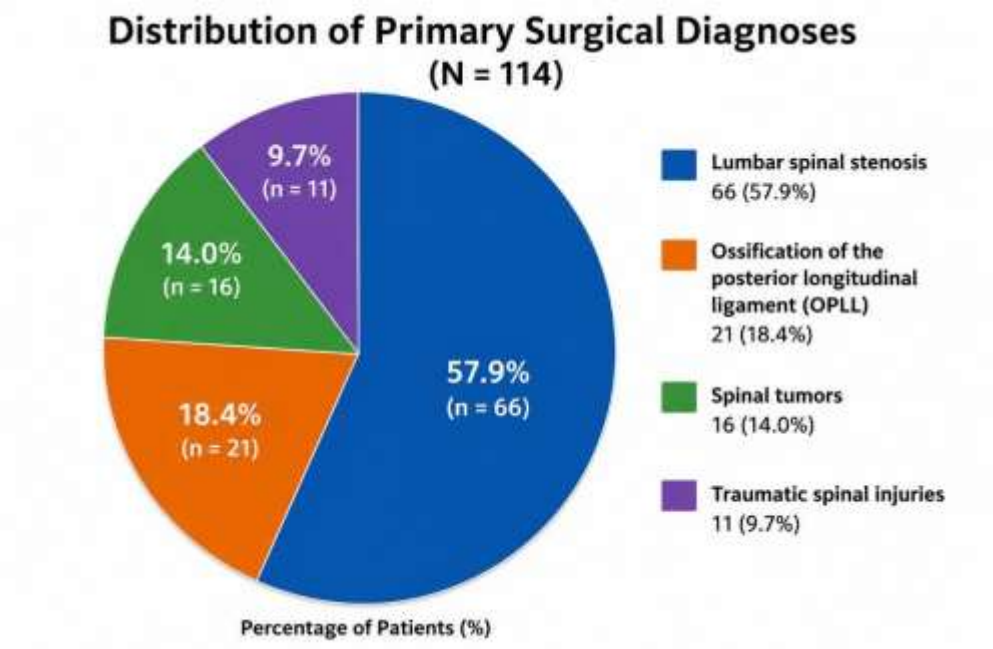
Methodology

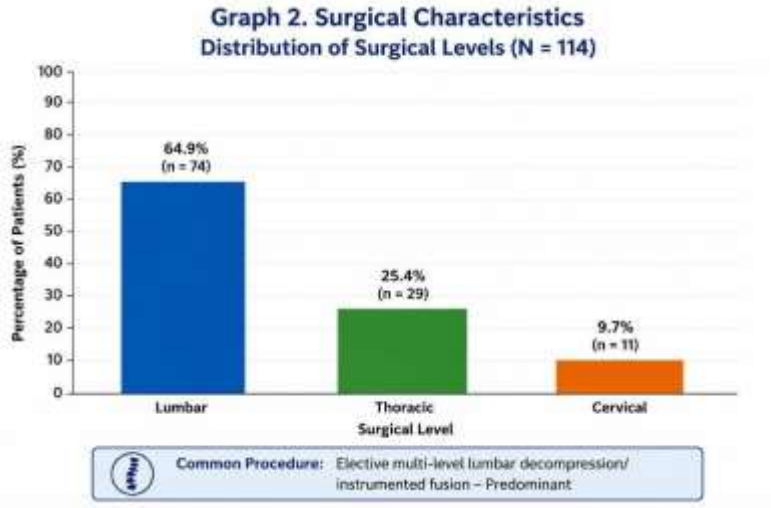
This retrospective cohort study analyzed clinical data from patients who underwent spinal instrumentation between 2018 and 2024 and experienced documented postoperative cerebrospinal fluid leakage. A standardized clinical protocol was uniformly applied to all subjects, mandating strict flat-prone bed rest for the initial 48 hours followed by a gradual postural transition strategy. Clinical outcomes were systematically evaluated by measuring the total duration required for the complete resolution of cerebrospinal fluid drainage and the aggregate length of the postoperative hospital stay. Additionally, patient demographic variables and the specific spinal levels involved in the primary procedure were recorded to assess their influence on the efficacy of the prescribed immobilization protocol. Statistical analysis involved multivariate regression to determine the correlation between the anatomical level of the dural defect and the time to clinical resolution under the standardized protocol.

Results. The study cohort comprised 114 patients, all of whom were over five years of age, with

a mean age of 62.4 years; Male were n=70 and female n=44.

subjects predominantly underwent elective multi-level lumbar decompression or instrumented fusion. The median time for complete resolution of postoperative cerebrospinal fluid drainage following the mandated 48-hour flat-supine bed rest protocol was 4.8 days (interquartile range: 3.2–6.5 days). Notably, multivariate regression analysis identified no statistically significant correlation between the anatomical level of the dural defect and the time to clinical resolution. During the clinical follow-up, eight patients (7.0%) necessitated surgical revision due to persistent leakage or symptomatic pseudo-meningocele, while wound-related complications, including superficial infection, occurred in five patients (4.4%), outcomes which align with recent evidence suggesting that early mobilization is a safe and effective postoperative strategy compared to prolonged bed rest.These outcomes demonstrate that the prescribed 48-hour flat-supine rest protocol effectively managed postoperative cerebrospinal fluid leakage in this cohort, with minimal rates of secondary surgical intervention or infectious complications .Figure 3. Furthermore, the absence of deep surgical site infections or neurological deficits in the study population suggests that early, guided mobilization following the initial rest period does not compromise long-term dural integrity. The cohort predominantly comprised patients with lumbar spinal stenosis (58%), followed by ossification of the posterior longitudinal ligament (18%), spinal tumors (14%), and traumatic spinal injuries (10%), Figure-1 with surgical procedures involving the lumbar spine (65%), thoracic spine (25%), and cervical spine (10%). Figure 2


Distribution of Primary Surgical Diagnoses
(N = 114)
9.7%
(n = 11)
14.0%
(n = 16)
57.9%
(n = 66)
18.4%
(n = 21)
Lumbar spinal stenosis
66 (57.9%)
Ossification of the posterior longitudinal ligament (OPLL)
21 (18.4%)
Spinal tumors
16 (14.0%)
Traumatic spinal injuries
11 (9.7%)
Percentage of Patients (%)


Graph 2. Surgical Characteristics
Distribution of Surgical Levels (N = 114)
Percentage of Patients (%)
100
90
80
70
60
50
40
30
20
10
0
64.9%
(n = 74)
25.4%
(n = 29)
9.7%
(n = 11)
Lumbar
Thoracic
Cervical
Surgical Level
Common Procedure: Elective multi-level lumbar decompression/ instrumented fusion – Predominant

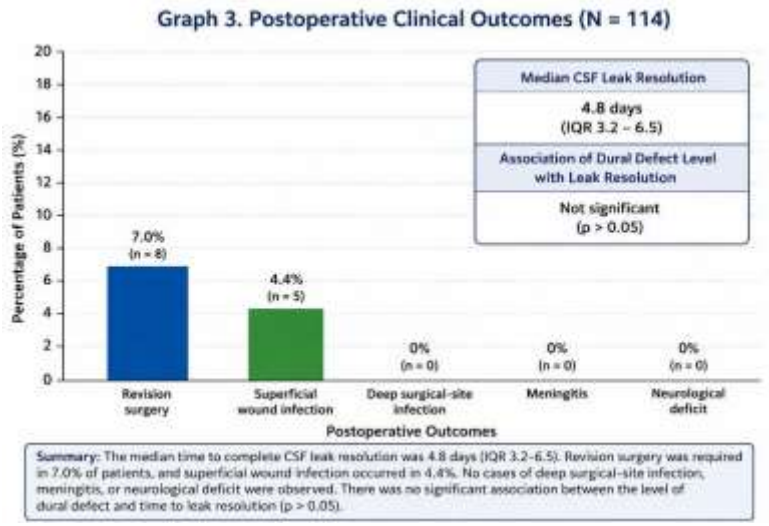


Table 1. Multivariate Regression Analysis of Factors Associated with CSF Leak Resolution

Variable	**Finding**	**p-value**
Anatomical level of dural defect	No significant association with time to CSF leak resolution	>0.05

Discussion

The present investigation demonstrates that a systematic regimen of strict bed rest followed by controlled postural adjustment facilitates the resolution of the vast majority of postoperative cerebrospinal fluid leaks. These observations align with studies examining the role of patient positioning and restricted activity in dural defect management ,[7] although the retrospective nature of this study and the lack of a control group highlight the need for further prospective randomized trials to clarify the optimal immobilization duration across diverse patient populations. Nevertheless, the high success rate observed here reinforces the efficacy of conservative management as a primary strategy for addressing persistent dural defects. While our findings confirm the efficacy of initial conservative management,, they also resonate with recent literature discussing the efficacy of alternative drainage systems.,[8,9.] Despite the high success rate and minimal secondary interventions observed in our cohort, the study's retrospective design and lack of a randomized control group preclude definitive conclusions, suggesting that future prospective trials are essential to rigorously compare the merits of early-mobilization protocols against active drainage strategies to optimize postoperative recovery. These findings highlight the potential for optimizing recovery pathways by shifting toward early-mobilization protocols that emphasize patient comfort without augmenting the risk of late-onset dural failure. Future prospective trials are warranted to further delineate the precise mechanical thresholds at which postural transitions can be safely accelerated without increasing the incidence of symptomatic dural sac dehiscence. Refining these parameters could establish a standardized, evidence-based framework for postoperative management that prioritizes both dural healing and the mitigation of immobilization-related morbidity. Ultimately, although the lumbar spine accounted for the highest incidence of cerebrospinal fluid leakage in this cohort, the implementation of these streamlined recovery pathways may reduce healthcare resource utilization while simultaneously

improving patient-reported outcome measures following complex spinal interventions

Overall, these findings reinforce the value of a conservative-first approach in mitigating the need for invasive secondary repairs following incidental durotomy.[10] However, clinicians must balance these conservative strategies with the inherent risks of prolonged immobilization, such as venous thromboembolism and pulmonary complications, which are frequently reported in surgical literature.[11] Consequently, future clinical studies should integrate standardized mobilization milestones to better differentiate between the resolution of occult leaks and the necessity for mechanical intervention. Furthermore, these data support the use of conservative management as a primary intervention, aligning with existing case series that prioritize non-invasive strategies over immediate surgical re-exploration.[12] Given the limitations inherent in retrospective observational designs and the absence of a dedicated control group, these findings emphasize the necessity for multi-institutional, prospective investigations to establish a gold standard for non-operative recovery protocols.[13,14.] Such investigations should prioritize the inclusion of homogeneous patient populations to better characterize the influence of pathology-specific factors on dural healing dynamics[15.] Developing consistent, large-scale prospective standards for patient movement will help determine the ideal timeframe for postoperative rest while simultaneously allowing for the incorporation of modern sealing agents and regenerative materials into routine care, ultimately improving recovery outcomes and minimizing risks associated with prolonged inactivity. Additionally, incorporating standardized outcome reporting for recurrence and dural integrity in future trials will be essential to reduce data variability and improve the reliability of these non-operative management protocols[16]. However, the reliance on retrospective data in this study introduces potential selection bias, and the absence of a standardized assessment of patient activity levels during the recovery period remains a significant limitation. Future prospective efforts should address this by implementing objective,

real-time activity tracking to better quantify compliance with immobilization protocols. Recent advancements, such as the development of smart, absorbent wound dressings that can detect fluid composition and quantify leakage volume without requiring manual inspection, hold significant promise for enhancing the precision of conservative management. By integrating these emerging technological solutions with tailored fluid management, clinicians can refine the balance between promoting dural healing and enabling safe, early functional recovery. Moving forward, multicenter registry data will be vital to overcome the constraints of historical cohort analysis and confirm whether these non-invasive protocols maintain long-term dural integrity across diverse surgical demographics[17]. Establishing these rigorous, prospective evidentiary standards will ultimately diminish reliance on subjective clinical observation and provide the data necessary to refine recovery benchmarks for complex dural reconstruction. Furthermore, such initiatives should specifically categorize dural sealant patch utilization alongside conservative measures to better distinguish the contributory effects of pharmacological sealing versus mechanical postural stabilization.

Conclusion.

The implementation of conservative postural management demonstrates significant efficacy in addressing the majority of postoperative cerebrospinal fluid leaks, thereby preventing unnecessary reoperations. Moreover, the adoption of standardized bed rest protocols significantly decreases the frequency of surgical revisions in carefully selected patient populations, underscoring the clinical utility of conservative care.

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