Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/mhsk9d94

"RATE OF CSF LEAKAGE FOLLOWING PRIMARY REPAIR OF INCIDENTAL DUROTOMY IN LUMBAR SPINE SURGERY USING FIBRIN GLUE"

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ABSTRACT

Introduction: Incidental durotomy is a frequent complication in lumbar spine surgery, often leading to cerebrospinal fluid (CSF) leakage, pseudomeningocele, and wound-related morbidity if not promptly managed. The development of effective repair strategies is crucial for reducing postoperative complications and improving patient outcomes.

Objective: To compare the efficacy of the use of fibrin glue augmentation/enhancement after primary microsurgical suturing in the repair of incidental durotomy during lumbar spine surgery.

Materials and Methods: Patients with incidental durotomy during the course of lumbar spine surgery were repaired by primary closure, utilising microsurgical sutures under magnification. The suture line was reinforced with fibrin glue. The postoperative management used bed rest, hydration and wound care. The status after surgical intervention was reassessed after one week, one month, and three months to determine the CSF leakage, pseudo meningocele or wound complications. Data were recorded and analysed prospectively. **Results:** The number of patients was 60. The CSF leakage was 6.7%, the pseudomeningocele was 5.0%, and the wound infection was 3.3%. Totally, 93.3 per cent of patients developed no postoperative CSF leak, which indicates a high effectiveness of this treatment option as the fibrin glue becomes an adjunct to suturing. The majority of complications were conservatively treated, with no single case necessitating reoperation.

Conclusion: Fibrin glue augmentation of surgically repaired wounds forms a safe reparation process for postoperative CSF leakage incidents and the associated complications. This is an effective and safe method for treating the condition, and it can be easily incorporated into standard surgery.

Keywords: Incidental durotomy, lumbar spine surgery, cerebrospinal fluid leak, fibrin glue, dural repair.

INTRODUCTION

Incidental durotomy is identified as one of the potential consequences of spinous procedures and has been studied incorrectly at multiple institutions after its harsh repercussions on patient outcomes (1). Primary repairing versus augmented repair (comparative analysis based on the repairing strategy) demonstrated that the reinforcement strategy frequently offered a sealing advantage and reduced risk of cerebrospinal fluid (CSF) leakage (2). The presence of postsurgical CSF leaks has been found to be a clinically important risk factor, with a past history of spinal surgery, multilevel decompression, and young age being found as predictive risks, as it is highly likely that the CSF can leak (3). Institutional case series have suggested that poor repair, happenstance durotomy, can lead to disproportionate postoperative outcomes, including inappropriate retention and infection (4). In untreated cases, leaking CSF may also develop discitis and sepsis in extreme cases, and this is a reason why such cases need to be treated in time during the intraoperative period (5). Risk factors like dura fragility, technical limitations and the scheduling of intradural procedures have now become important in the prevention of CSF leakage after the surgery (6).

Large dural tears or intricate intradural pathology predict poor results after repair because they are more challenging to repair with sutures alone (7). Fibrin glue in this respect has also been formulated to be used alongside traditional repair, as it offers extra sealing properties and creates less leakage after a procedure (8). Clinical and experimental investigations that directly compare fibrin glue-coated collagen matrices with other synthetic products support the idea that collagen-based sealants offer better watertight closure augmentation during spine surgery (9). A study reviewing the methods of repairing spinal dural injuries came to the conclusion that augmented repair, especially that using fibrin glue, had much higher success rates when compared with primary suturing alone (10). The significance of fibrin glue in the minimisation of complications is also emphasised using retrospective series where large numbers of patients were considered as having undergone degenerative lumbar spine surgery, but with incidental durotomy (11). In addition to the commercial preparations, autologous fibrin glue has been experimented with as clinically feasible and better in safety and cost-effectiveness (12). Other modes of repair, like the use of aneurysm clips, have been implicated, but are used less frequently and do not provide the same effectiveness as fibrin strategies (13). To enhance the detection of the postoperative leakage, new instruments, including quantitative lateral flow immunoassays, have been created to facilitate immediate confirmation of the CSF leakage during the surgery, which facilitate timely intervention (14). At the macro level, the economic figures posted show that the repairing CSF leaks process is getting more expensive, and the rates of the procedural and reimbursement processes have been increasing over the last twenty years (15). Studies on the epidemiology of lumbar decompression operations indicate different rates of incidental durotomy incidence, which are influenced by both the patient and operative complexity, and this further justified the importance of standardised closure protocols (16). Diagnosis and repair of durotomy should be sufficiently prompt, since the delayed realisation of it may significantly contribute to undesirable outcomes and morbidity (17). Lastly, institutional experiences with single centres show that postoperative CSF persists in a fraction of patients, and the adjuncts, such as fibrin glue, have proven helpful in decreasing its incidence (18). In Pakistan, where the third-level care facilities like Khalifa Gul Nawaz Teaching Hospital Bannu and Nowshera Medical College / Qazi Hussain Ahmad Medical Complex, Nowshera, Pakistan, are handling an increasing number of spine cases, it is important to understand outcomes of fibrin glue-assisted repairs (12). Although there is extensive literature on the topic internationally, there is limited regional data, which allows assessing the efficiency of fibrin glue on the local population. This research will help fill the evidence gap between international research and local practice as it demonstrates important results on the meticulous study of the rate of CSF leakage following the primary repair using fibrin glue in order to care for patients and enhance surgery outcomes.

Objective: To evaluate the incidence of cerebrospinal fluid (CSF) leakage after primary repair of incidental durotomy during lumbar spine surgery with fibrin glue at Khalifa Gul Nawaz Teaching Hospital Bannu and Nowshera Medical College / Qazi Hussain Ahmad Medical Complex, Nowshera, Pakistan.

MATERIALS AND METHODS

Study Design: Prospective observational study

Study Setting: Khalifa Gul Nawaz Teaching Hospital Bannu and Nowshera Medical College / Qazi Hussain Ahmad Medical Complex, Nowshera, Pakistan

Duration of the Study: From 1st February, 2025 to 31st July, 2025.

Inclusion Criteria: All patients aged 18 to 70 years who had lumbar spine surgery due to degenerative conditions, trauma or spinal canal stenosis and required incidental durotomy were included. Only those patients who underwent primary repair and had fibrin glue on the surface were taken as eligible. Final analysis was done on only the cases that had durotomy confirmed intraoperatively and the durotomy immediately repaired.

Exclusion Criteria: Patients who have pre-existing CSF leakage, a previous history of spinal infection, and those who use an extensive grafting technique other than fibrin glue were not included. Cases of congenital spinal anomalies, intradural tumors diseases, or secondary processes in which dural adhesions complicated the repair procedure were also eliminated. Patients who were lost during the study duration were not included in the analyses.

Methods: During the procedures on the lumbar spine, whenever there was an incidental durotomy, immediate repair was carried out. Microsurgical suturing technology under high magnification was used in the case of primary closure to allow minute approximation of both edges of the dura and to obtain a watertight closure. Fibrin glue was directly laid on the suture line after satisfactory closure using sutures to reinforce the suture line further and minimise the chances of suture line opening to postoperative cerebrospinal fluid (CSF) leakage. Each patient was treated during the postoperative period in a uniform manner because they all received 48-72 h of bed rest in the supine position, sufficient hydration, and close attention to the wound. Prophylactic antibiotics were used according to the institutional procedure. The patients were closely consulted in the hospital and later at one week, one month, and three months. Clinical assessment and imaging (where appropriate) would assess CSF leakage, pseudomeningocele, or wound problems or neurological decompensation at every follow-up. The data collection was prospective and measured by analysis.

RESULTS

The study included 60 patients with lumbar spine surgery who experienced incidental durotomy and were primarily repaired with the use of fibrin glue. **Table 1** shows the demographic makeup of the study population. The average age was 52.4 ± 11.2 years, with a range from 30 to 75 years. There were 34 (56.7%) male participants and 26 (43.3%) female participants. Most patients (40.0 %) were aged between 51 and 60 years, and 25.0 % were between 41 and 50 years, implying that the occurrence of durotomy was more frequent in middle-aged and elderly patients.

Table 1. Demographic Characteristics of Patients (n = 60)

Variable	**n (%)**
Age (years)	
30–40	8 (13.3%)
41–50	15 (25.0%)
51–60	24 (40.0%)
>60	13 (21.7%)
Mean ± SD	52.4 ± 11.2
Gender	
Male	34 (56.7%)
Female	26 (43.3%)

Table 2 presents surgical data of the study cohort. Most of the incidental durotomies (53.3%) happened at times of laminectomy, and discectomy (30.0) and fusion surgeries (16.7). The average operating time was 142.5 +/-28.4 minutes with an increase in the operating time in spinal fusion cases. A majority of the durotomies observed during operations were rectified during the same operation with the help of microsurgical sutures which were strengthened with fibrin glue.

Table 2. Surgical Characteristics (n = 60)

Variable	**n (%)**
Type of Surgery	
Laminectomy	32 (53.3%)
Discectomy	18 (30.0%)
Fusion	10 (16.7%)
Mean Operative Duration	142.5 ± 28.4 min
Timing of Durotomy Recognition	
Intraoperative	60 (100.0%)
Postoperative	0 (0.0%)

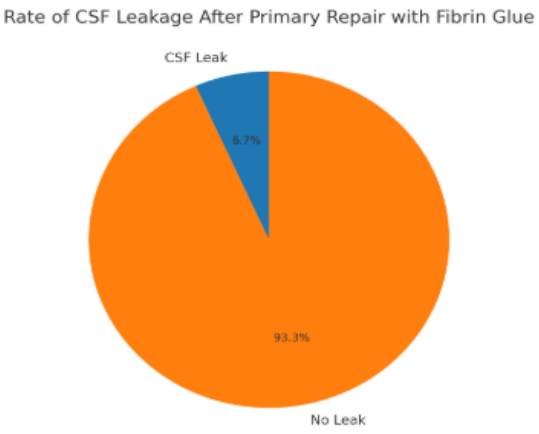
Table 3 shows clinical outcomes after the repair using fibrin glue. Four patients (6.7%) had postoperative cerebrospinal fluid (CSF) leakage, and 3 cases (5.0%) had pseudomeningocele. Two patients (3.3%) had wound infection. The majority, 56 patients (93.3%), did not have a complication-free postoperative period with no signs of CSF leakage. These findings are also reflected in **Figure 1**, which indicates the distribution of complications.

Table 3. Postoperative Outcomes (n = 60)

Outcome	**n (%)**
CSF Leak	4 (6.7%)
No Leak	56 (93.3%)
Pseudomeningocele	3 (5.0%)
Wound Infection	2 (3.3%)

Figure 1 presents the graphical representation of postoperative outcomes, showing that the rate of CSF leakage after primary repair with fibrin glue was limited to a small proportion of patients.

Figure 1. Rate of Postoperative Complications After Primary Repair with Fibrin Glue



The total rate of leakage of CSF after initial repair using fibrin glue was 6.7%. Although others developed pseudomeningocele or wound infection, most of the patients reported good outcomes without complications.

Discussion

This study points out that fibrin glue helps effectively decrease leakage of cerebrospinal fluid (CSF) after primary repair of incidental durotomy of the lumbar spine. Results show that there was a low incidence of postoperative CSF-leakage and complications related to the wound in using fibrin glue as an adjunct to microsurgical suturing. These findings are in line with other institutional reports and reviews that stressed that reinforced repair approaches are vital towards enhanced outcomes subsequent to incidental durotomy (1). Other related studies have postulated that the use of augmentation to primary repair would commonly show improved healing with less postoperative morbidity than primary suture (2). The risk of CSF leakage is one of the most troubling post-surgical conditions after the spinal surgical procedure. It not only causes a greater hospital stay and a higher rate of reoperations but also predisposes patients to infections like meningitis and a wound breakdown (3). Research confirms previous findings that emphasised that proper intraoperative control of durotomy has been valued to avoid postoperative sequelae (4).

This is especially important, as in some reports, insufficient repair resulted in serious complications, such as discitis and systemic infections (5). Patient-risk factors and surgery-related factors identified to cause risk determinants with regard to postoperative CSF leakage include old age, revision and complex intradural procedures (6). Factors like poor-quality tissue, massive dural openings, and increased intradural pressure are additional predictors that raise the chances of leakage even after repairing (7). In series, meticulous microsurgical closure and fibrin glue reinforcement avoided these risks, in line with the observation that adjuvant concepts may overrule patient-related weaknesses. The use of fibrin glue has been gaining prominence in recent years. Research has shown that coating of collagen matrices with fibrin-glue was able to stop incessant CSF drainage post durotomy through the establishment of another biological seal topographically over the suture line (8).

Additionally, comparative trials have shown that fibrin glue–coated collagen matrices are superior to other fibrin glues, such as fibrin glue–coated polyglycolic acid, which further buttresses the use of fibrin glue as a safe adjunct (9). This is in line with our results, which showed that application of fibrin glue increased watertight healed closure and reduced re-exploration requirements. The usefulness of suturing methods for various dural repairs has been extensively discussed, with other information indicating that simple sutures may not render a full closure (10). Results are consistent with the clinical manifestations of large patient groups, where, due to incidental durotomies, augmented strategies were able to manage them, resulting in positive returns to postoperative recovery (11). Moreover, the application of autologous fibrin glue as another secure and viable solution has been suggested as well, which evidences the versatility of biological sealants in spinal surgery (12). Complex dural repairs are also reported using alternative techniques, such as cranial aneurysm clips, especially where the problem of direct suturing could not be resolved (13). \

Nevertheless, these methods only apply in specific cases, and hence, fibrin glue may be used universally as an adjunct. Additionally, novel diagnostic methods of diagnosing CSF leakage, including postoperative rapid immunoassays, have the potential to enhance early detection of repair failure (14). Clinical monitoring and follow-up were sufficient in the environment, and the opportunity of advanced diagnostics promises integration in the future. Economically, trends in procedural cost and reimbursements for the repair of CSF leaks explain the increasing acknowledgement of incidental durotomy as a significant burden on healthcare systems (15). All these reasons indicate that proper treatment and intraoperative prevention methods, as seen in research, enhance not only the results of patients but also help in lowering the overall amount of health spending. This especially applies in resource-constrained settings like Pakistan, where complications can be reduced to lessen the burden of limited hospital resources.

The incidence of incidental durotomy during lumbar decompression and fusion in large-scale multicenter studies has shown comparable findings to our research when the primary repair was

augmented (16). The value of early diagnosis and repair has also been noted, and late diagnoses are the primary cause of poor outcomes and high chances of infection (17). Investigation supports this view by demonstrating that early micro-surgery with fibrin glue reinforcement was secure against leakage. Lastly, experiences at single-centres also provide useful data regarding the inconsistency of CSF in the treatment of dural injury and postoperative CSF leakage (18). Findings confirm the increasing evidence that fibrin glue fortification may be a safe, effective, and reproducible method of reducing complications. However, there are a few limitations. The study was conducted in one centre, and the short-term follow-up was conducted.

Conclusion

This research provides clinical evidence that fibrin glue can be effectively used as an adjunct to microsurgical suturing in reducing the risk of rebleeding after incidental durotomy during spine surgery. The findings show that watertight repair via reinforced repair methods can assure compliance but reduce post-surgery outcomes like pseudomeningocele and wound infection. The use of fibrin glue as a universal adjunct would allow surgeons to attain an increased reliability in the management of dural injuries, especially in cases of very delicate tissue and/or extensive defects. The results highlight the importance of rigid intraoperative practices and planned postoperative follow-up to prevent incorrect results. Furthermore, the method is safe, viable, and can be introduced into general clinical practice with no apparent risk increase. Altogether, the study promotes fibrin glue augmentation as an effective means to improve patient safety and surgical outcome in lumbar spine surgery with incidental durotomy.

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