ORIGINAL ARTICLE

Incidence & Management of Delayed Cerebrospinal Fluid Leaks after Lumbar Spinal Surgery-Analysis of 10 Cases

MUHAMMAD MUKHTAR KHAN, FAIQAFILZA KHAN, WASEEM DAD KHAN IRFAN JAN, SOHAILDAUD KHAN, TARIQ KHAN

Department of Neurosurgery, Northwest General Hospital & Research Centre, Peshawar – Pakistan

DOI: https://doi.org/10.36552/pjns.v23i3.363

ABSTRACT

Objectives: *Cerebrospinal fluid (CSF) leaks in degenerative lumbar spine surgery are common, however, delayed cerebrospinal fluid (CSF) leaks are quite rare in neurosurgical practice. Literature regarding its incidence and management is scant.Our aim was to describe the incidence & management of delayed CSF leaks after degenerative lumbar spine surgery.*

Material & Methods: *This was a prospective study where all patients operated for lumbar disc or stenosis, who presented with the delayed CSF leak (> 1 week postoperatively) without intraoperative record of incidental durotomy were included. Data was collected about demographics, diagnosis, operative detail, postoperative course & management issues.*

Results: *Ten out of 1128 patients developed delayed CSF leaks (0.89%). Mean age at the time of diagnosis was 52.1 ± 6.9 years with 6 (60%) males & 4 (40%) female. The most common spinal level was L5-S1 (50%). Eighty percent (n = 8) patients underwent primary surgery while 20% (n = 2) were revisions. Clinical features were headaches (80%), dizziness (70%) and altered sensorium in 20%. Mean time of the leak was 17.3 ± 2.2 days. Two patients resolved with bed rest and compression dressing while the lumbar drain was placed in 80%. Three (30%) patients of the 8 needed open repair of the dural defect. Complications of the CSF leak included wound infection in 60%, and meningitis in one (10%) patient. There were no cases of neurologic deficit. One case eventually developed infective discitis.*

Conclusion: *Delayed cerebrospinal fluid leaks are rare, but pose significant postoperative problem in terms of potential wound complications, functional status and treatment costs. The majority of these leaks are amenable to conservative measures such as bed rest and lumbar drainage. However, about one third of these patients require open surgical repair*

Keywords*: Lumbar spine, cerebrospinal fluid leak, delayed, management.*

INTRODUCTION

Surgery for degenerative lumbar spine disease has a diverse variety of complications. Incidental dural tear of the lumbar thecal sac is common & is reported in up to 17%.[1] Most of the dural tears are usually noticed intraoperatively, however in some patients they only present with CSF leak in a delayed manner. Dural tears, which are noticed intraoperatively, are repaired; however, those, which are some how missed during the index surgery, may lead to a high propensity of postoperative CSF leak with its associated risks.[2]

The aetiologies of delayed CSF leaks can be many folds, and several are reported in the literature such as missed tears, tears caused by bony spicules and partial thickness tears that may later convert to full thickness.[3,4,5] Whether these durotomies with delayed CSF leaks pose higher risks is obvious and several studies have suggested a higher risk of complications such as hypotensive headaches, subarachnoid hemorrhage & wound infections in these patients.[6,7]

Since, the delayed CSF leaks are very rare with a reported range of 0.59% – 0.85%, literature regarding

Date of Submission: 31-7-2019
Date of Printing: 30-9-2019

their management is also sparse.[6,8] Additionally, it remains to be seen whether same protocol of care be applied to these patients similar to those with in whom dural tears are detected intraoperatively and repaired.[9,10] Management of CSF leaks secondary to dural tear in lumbar spine surgery is a daunting task and a source of controversy. A majority of authors recommend an aggressive approach in CSF leaks, however some authors suggest initial conservative measures with strict bed rest and gradual mobilization.[11,12]

We present our experience with managing delayed CSF leaks following surgery for the degenerative lumbar spine with an aim to emphasize the importance of judicious clinical decision-making.

MATERIALS AND METHODS

Study Design

This is a retrospective review of prospectively collected data. The study was conducted at the department of neurosurgery, Northwest General Hospital & Research Centre, Peshawar, between January 2017 to June 2019.

Inclusion Criteria

We included adult patients (18 – 80 years) operated for degenerative lumbar spine disease (disc herniation/ spinal stenosis) and those who presented with CSF leak after 14 days of surgery.

Exclusion Criteria

Patients with instrumented spinal fusion was done for any reason, those with intraoperatively noted durotomy and those in whom dura was opened intentionally (tumor resection) were excluded.

Data Collection Procedure

Since it was a retrospective review of the prospectively maintained patient database, approval for the study was not required according to local review board regulations. All patients provided informed consent before undergoing any surgical intervention.

For the purpose of the study, we defined delayed CSF leak as discharge of clear, watery fluid occurring after the7th postoperative day or after removal of skin stitches in patients in whom no note was made of intraoperative incidental durotomy. A detailed clinical history & examination was performed and a note was made of clinical features such as low pressure headaches, altered sensorium, dizziness, fever and wound condition.Data was collected about demographics, postoperative day at which the leak started, additional procedures that were undertaken and wound culture results in those cases, who had infected wounds on initial examination. Our management strategies were as follows: postoperatively, upon discharge, we call the patient at 14 days postoperatively. During this visit, the overall health condition of the patient is evaluated focussing on the resolution of the sciatic pain, wound related complaints, general wellbeing and examination of the wound. Patients in whom we noted delayed CSF leaks were checked against their procedure notes to check whether a note of intraoperative durotomy was made.

Delayed CSF Leak, Management Protocol

1. Bed Rest etc.

All patients with delayed leaks were admitted and started on intravenous broad-spectrum antibiotics after sending wound cultures. Initially, we applied a compression bandage with a large gauze pack & checked it for the degree of soaking in the next morning. Skin stitches were applied in the case of dehiscent wounds. In some patients, we applied one or two interrupted skin stitches at the incisional leak site. Patients were advised to have complete bed rest in the supine position.Those with hypotensive headaches were provided adequate analgesia and optimal intravenous hydration **(Fig. *1*).**

In the next morning, those who responded to bed rest, compression bandage & skin stitches, with minimally soaked dressing, continued with strict bed rest for next 48 hours. If the leak resolved, we kept the patient for another 72 hours with gradual mobilization and 24 hourly dressing checks. If the wound remained dry, we discharged the patient after 3rd to 5th day of admission and asked to follow-up at one-week interval. The new stitches were removed in 10 – 14 days.

2. Lumbar Drainage

However, if the incisional leak did not respond to these measures until the morning after the day of admission, we placed a lumbar drain at bedside. Lumbar drainage was continued for the next 24 hours, after which the wound was assessed. If the dressing

was dry, the head of the bed was elevated to 30 – 45 degrees after another 24 hours of bed-rest. The next day, if the dressing was dry, the head of the bed was elevated gradually to 30 – 4º. After 72 hours of bed rest and head of bed elevation, the patient was allowed short trips of walking, such as going to the toilets or changing between bed & chair.

3. Open Repair

If the dressing became soaked after lumbar drain or after mobilization the next day, we listed the patient for open repair of the dural tear.

Statistical Analysis

All patients were followed for at least 6 months postoperatively and were assessed for any complications related to functional outcome and complications of CSF leaks. The data was stored in a Microsoft Excel sheet. Statistical significance was kept at ≤ 0.05.

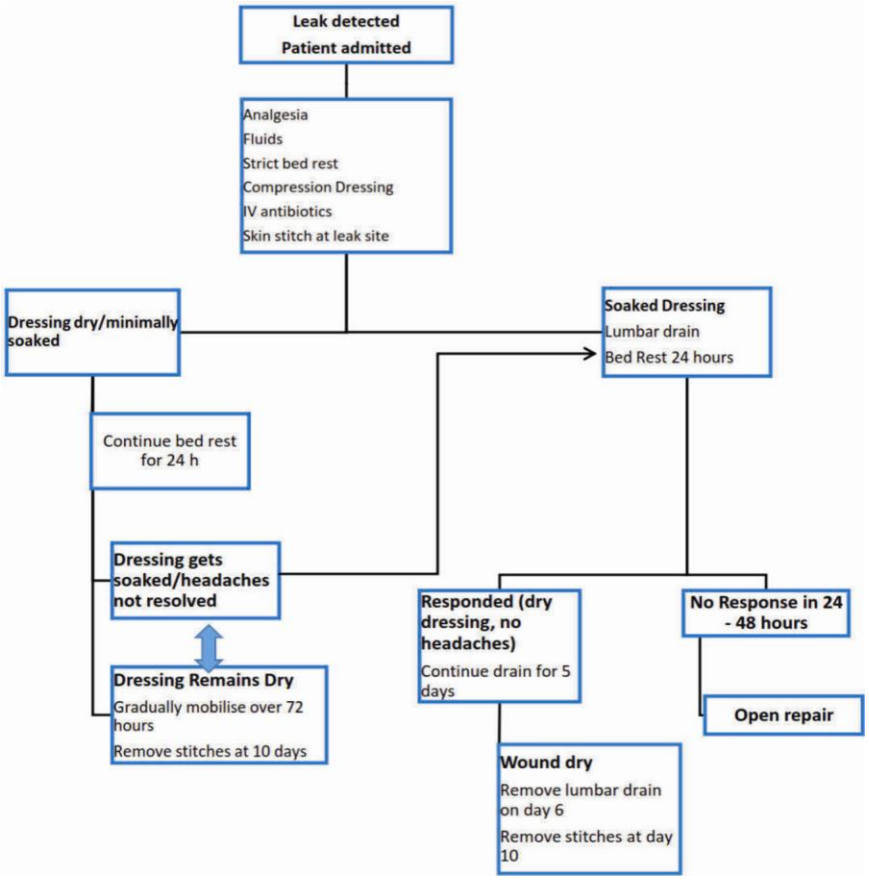


Fig. 1: *Delayed CSF leak management protocol.*

RESULTS

Demographics

A total of 1128 surgeries was performed during the study period for degenerative lumbar spine disease out of which 10 patients developed delayed CSF leaks (0.89%). There were 620 (54.9%) males & 508 (45.1%) females. During the study period, we observed 10 (0.89%) patients with delayed CSF leaks. The mean age at the time of diagnosis was 52.1 ± 6.9 years (range: 42 – 60). There were 6 (60%) males & 4 (40%) female patients.

General Features

The most commonly involved spinal level was L5 - S1 (50%), which was followed by L4 – L5 in (40%) and L3-L4 (10%). The distribution of decompression only and decompression with discectomy was 50% (n = 5) each. Eighty percent (n = 8) patients underwent primary surgery while 20% (n = 2) underwent revision surgery. The demographics and clinical features are summarized in **Table 1**.

Clinical Features

Presenting clinical features were headaches (80%), dizziness (70%) and altered sensorium in 20%. The mean time of the leak was 17.3 ± 2.2 days (range: 12 – 30) where 70% presented within the first 15 days of the leak.

Management Protocol

Two (20%) patients resolved with bed rest and compression dressing, while the lumbar drain was placed in 80%. Three (30%) patients of the 8 needed open repair of the dural defect. In all three patients, the leak was identified at the second surgery. Two patients had a small puncture site at the dorsal dural surface while one patient had a leak near the root sleeve, anteriorly. We could not correlate a bony spicule to the

Table 1: *Patients and their clinical attributes.*

No.	Age	Gender	Spinal Level	Diagnosis	Procedure	Leak Day	Intervention	Outcome
1.	42	Male	L5 – S1	PID	Microdiscectomy	12	Lumbar Drain + Reoperation and Primary Repair	Leak Stopped
2.	58	Male	L4 – L5	Stenosis	Laminectomy	14	Lumbar Drain	Leak Stopped
3.	60	Male	L4 – L5	Stenosis	Laminectomy	15	Lumbar Drain + Reoperation and Primary Repair	Leak Stopped
4.	46	Female	L4 – L5	Stenosis	Laminectomy	14	Lumbar Drain + Reoperation and Primary Repair	Leak Stopped
5.	45	Female	L3 – L4	PID	Open Discectomy	16	Lumbar Drain	Leak Stopped
6.	45	Male	L3 – L4	PID	Open Discectomy	12	Bed Rest	Leak Stopped
7.	60	Male	L3 – L4	PID	Open Discectomy	30	Lumbar Drain	Leak Stopped
8.	55	Female	L4 – L5	PID	Microdiscectomy	15	Bed Rest	Leak Stopped
9.	55	Male	L4 – L5	Stenosis	Laminectomy	15	Lumbar Drain	Discitis
10.	55	Female	L5 – S1	Stenosis	Laminectomy	30	Lumbar Drain	Leak Stopped

causation of the dural tear. After open repair, we placed a size 12 drain for 7 days. The stitches were removed at 14th postoperative day after a wound inspection (**Fig. 1) (Table 2).**

Table 2: *Management.*

Management Steps	No.	Percentage	Outcome
Bed rest only	2	20%	Recovered
Lumbar drain	8	80%	5 cases recovered
Open surgery	3	30%	Recovered 2 cases
			Discitis 1 case

Complications

Complications of the CSF leak included wound infection in 60%, while meningitis was observed in only one patient at presentation. One case who was re-operated at 30th postoperative day, had developed a pseudomeningocele. Wound culture was positive in five patients where diverse varieties of organisms were identified, including pseudomonas, *E. coli*, Enterobacter, Klebsiella and mixed growths. This indicates that there is a very high risk of infection with virulent organisms which could have devastating consequences.

Follow-up

The mean follow-up duration was 8.8 ± 1.7 weeks (range: 6 – 12). During the follow-up, one patient developed signs and symptoms of discitis who showed E. coli on bacterial culture from the wound site. We could not grow an organism from the disc site tissue. The patient eventually developed bacterial osteomyelitis of the vertebral body and resolved after 6 weeks of intravenous antibacterial therapy.

The final outcome was categorized as favourable (leak stopped without major sequelae) in 90% of the patients, while one had unfavourable outcome who developed discitis and failed back syndrome.

DISCUSSION

The delayed CSF leaks following surgery for degenerative lumbar spine disease is a rare complication (0.28%).[13] The patients usually present late around the time they visit the clinic for stitches removal after which the CSF leak starts and eventually lead to wound complications. CSF leaks are common,

however, in most cases, the incidental durotomy is noted during the index surgery and primary repair is performed.[14] In delayed CSF leaks, the durotomy is missed during the index surgery and hence the only presenting feature is CSF leak through the wound with features of intracranial hypotension (headache, photophobia, dizziness etc.).[15] We undertook this study to present our experience about delayed CSF leaks. We have developed a protocol for patients presenting with CSF leaks (figure). We aimed to determine the efficacy of this protocol on successfully stopping CSF leaks. Second surgery besides associated with higher risk of complications are also costly, and in a private setup, patients are subjected to additional costs. The results of this study suggest that dural tears are encountered in older male patients. Patients with repeat procedures are at a higher risk for CSF leaks, since the dense fibrosis around the thecal sac makes the surgery challenging in terms of safe dissection. No difference exists for patients operated for lumbar disc herniation or spinal stenosis, however, in long standing cases, the lumbar dura becomes very thin and is at a higher risk for tears. The majority of CSF leaks are amenable to conservative measures such as bed rest, fluids and placement of a lumbar drain with gradual mobilization. Open surgical repair, though, providing a fair opportunity to repair the dural defect and hasten recovery, is associated with higher surgical risk (wound infection, sepsis) as well as also impose higher costs.

In a large retrospective review by Durand et al[6] from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database included 174 patients with analysis of risk factors associated with late presenting dural tears as well as risk factor analysis for associated complications. They reported a 97.7% reoperation rate with > 5% requiring 2 surgical procedures. They have identified procedure type, anatomic location, surgical approach, operative duration, and revision surgery as factors associated with increased incidence of dural tears. According to this study, increased likelihood was reported for the development of surgical site infection, wound disruption, sepsis, thromboembolism, pneumonia, UTI, andblood transfusion.[6]

In a retrospective review of 17 cases which developed delayed CSF leaks (5 postoperative day or later), Khazim et al[4] has reported a rate of delayed CSF leak of 0.83%. They used open surgical repair for 88.2% patients and did not find any difference in functional outcome for patients with or without delayed CSF leaks. Our study's definition of delayed CSF leaks was slightly different as we defined delayed leak which occur at or after the 7th postoperative day.

An abundant literature is available on the management of dural tears and CSF leaks in lumbar spine surgery, however, mostly the management is based ontears, which are identified during the surgery and are repaired.[5] The dural tears not observed at the index surgery are rare, hence repair is not done and discovered when the patient develops CSF leaks and its sequelae.[6] Bernatz et al[16] in a meta-analysis of 30-day readmission for spinal surgery patients, dural tear accounted for 4.9% (95% CI: 2.4 – 6.9).Our patients had a mean hospital stay of 9.6 ± 2.3 days. This is significantly longer to the average stay of patients not having CSF leaks.

Yoshihara et al[14] in a nationwide database analysis from Japan, reported incidental dural tear rate of 6.9% and identified male gender and hypertension as the major risk factors. Similarly, they reported that dural tears are the cause of significantly longer hospital stay as well as a significantly higher healthcare costs for those with dural tear. Tsutsumimoto et al[17] in a large prospective study has identified a dural tear rate of 5.05%. They reported equivalent Oswestry Disability Index for those with and without dural tears, however, the Japanese Orthopedic Association Scores were significantly lower for those with dural tears as compared to those without. An important observation was that most small dural tears are amenable to conservative treatment (bed rest, fluids, compression dressing) and surgical repair is required in a minority of patients. In our study, we did not observe any neurologic deficits and pain was resolved in all of the patients except for one with discitis.[17]

Takahashi et al,[18] in an anatomical study have identified 4anatomical zones of the lumbar thecal sac where dural tears are mostly encountered. These anatomical zones are; i) the caudal margin of the superior lamina, ii) cranial margin of the lower lamina, iii) index level disc, and iv) insertion point of the ligamentum flavum in the facet joint. In our study, since we only opened three cases surgically, two of the dural tears were observed to be located on the dorsal dural surface while one was located at the lateral surface near the dural root sleeve.

A lower intracranial pressure due to persistent leakage of CSF causes the clinical features of CSF leaks. This is why headache is exacerbated by head elevation and relieved while the patient lies flat or in Trendelenburg position. Some studies have suggested

that persistent leak and headache that persist despite rehydration and analgesia are indicators of early surgical repair. Saxler et al[19] has reported that patients with CSF leaks remain to experience backache and headaches for prolonged periods as compared to those without a durotomy. Cammisa et al[13] in a large retrospective review have reported no difference in the incidence of infection. This is contrary to our observation, where wound cultures were positive in 60% cases. However, it is important to note that only one patient eventually leads to the development of infective discitis with an unfavourable outcome.

A literature review suggested that, conservative treatment of unrepaired DT is not usually successful.[1,2,6,20,21] This statement is reasonable and true. However, a number of studies have suggested that conservative treatment may be successful in the majority of patients.[5,17] We have observed that dural leaks which are not identifiable during the index surgery are usually too small (1 mm puncture defects) and so these may be amenable to conservative therapy, although with a higher rate of pseudomeningocele formation and later symptoms of backache and lumbar radiculopathy. In high volume setups, or in private setups, an additional procedure may impose a significant cost on the patient and healthcare resources and conservative treatment could be pursued. In our study, 70% cases were resolved with conservative management protocol and open repair was required in only 30% patients.

Several operative repair techniques have been described which include primary repair, use of epidural tissue sealants, blood patch application, and fat/myofascial graft application. Cain et al[22] has presented the biologic sequence of events of the dural defect healing process. They have reported that fibroblastic bridging starts on day 6 of the injury and complete healing occur on day 10.

Literature on delayed CSF leaks is very limited and we are only starting to understand the phenomenon. Larger and longer follow-up studies are warranted to present the most suitable pathway for treatment. Our study may play a role as a primer for future studies that larger centres will undertake.

CONCLUSION

Delayed cerebrospinal fluid leaks after lumbar spine surgery for degenerative disease are rare but, pose significant postoperative problem in terms of potential wound complications, functional status and treatment costs. The majority of these leaks are amenable to conservative measures such as bed rest and lumbar drainage. However, about one third of these patients require open surgical repair.

Additional Information

Disclosures: Authors report no conflict of interest.

Human Subjects: Consent was obtained by all patients/ participants in this study.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

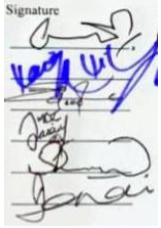
Address for Correspondence:

Muhammad Mukhtar Khan
Department of Neurosurgery, Northwest School of Medicine and Northwest General Hospital
Phase-V, Hayatabad, Peshawar – Pakistan
Email: kuzagar@gmail.com

REFERENCES

1. Guerin P, El Fegoun AB, Obeid I, et al. Incidental durotomy during spine surgery: incidence, management and complications. A retrospective review. Injury, 2012; 43 (4): 397-401.
2. Galarza M, Gazzeri R, Alfaro R, de la Rosa P, Arraez C, Piqueras C. Evaluation and management of small dural tears in primary lumbar spinal decompression and discectomy surgery. J Clin Neurosci. 2018; 50: 177-82.
3. Kothe R, Quante M, Engler N, et al. The effect of incidental dural lesions on outcome after decompression surgery for lumbar spinal stenosis: results of a multi-center study with 800 patients. Eur Spine J. 2017; 26 (10): 2504-11.
4. Khazim R, Dannawi Z, Spacey K, et al. Incidence and treatment of delayed symptoms of CSF leak following lumbar spinal surgery. Eur Spine J. 2015; 24 (9): 2069-76.
5. Khan MH, Rihn J, Steele G, et al. Postoperative management protocol for incidental dural tears during degenerative lumbar spine surgery: a review of 3,183 consecutive degenerative lumbar cases. Spine (Phila Pa, 1976), 2006; 31 (22): 2609-13.
6. Durand WM, DePasse JM, Kuris EO, Yang J, Daniels AH. Late-presenting dural tear: incidence, risk factors,

and associated complications. Spine J. 2018; 18 (11): 2043-50.
7. Menon SK, Onyia CU. A short review on a complication of lumbar spine surgery: CSF leak. Clin Neurol Neurosurg. 2015; 139: 248-51.
8. Sin AH, Caldito G, Smith D, Rashidi M, Willis B, Nanda A. Predictive factors for dural tear and cerebrospinal fluid leakage in patients undergoing lumbar surgery. J Neurosurg Spine, 2006; 5 (3): 224-7.
9. Syre P, Bohman LE, Baltuch G, Le Roux P, Welch WC. Cerebrospinal fluid leaks and their management after anterior cervical discectomy and fusion: a report of 13 cases and a review of the literature. Spine (Phila Pa, 1976), 2014; 39 (16): E936-43.
10. Takenaka S, Makino T, Sakai Y, et al. Dural tear is associated with an increased rate of other perioperative complications in primary lumbar spine surgery for degenerative diseases. Medicine (Baltimore), 2019; 98 (1): e13970.
11. Wang JC, Bohlman HH, Riew KD. Dural tears secondary to operations on the lumbar spine. Management and results after a two-year-minimum follow-up of eighty-eight patients. J Bone Joint Surg Am. 1998; 80 (12): 1728-32.
12. Wong AP, Shih P, Smith TR, et al. Comparison of symptomatic cerebral spinal fluid leak between patients undergoing minimally invasive versus open lumbar foraminotomy, discectomy, or laminectomy. World Neurosurg. 2014; 81 (3-4): 634-40.
13. Cammisa FP, Jr., Girardi FP, Sangani PK, Parvataneni HK, Cadag S, Sandhu HS. Incidental durotomy in spine surgery. Spine (Phila Pa, 1976), 2000; 25 (20): 2663-7.
14. Yoshihara H, Yoneoka D. Incidental dural tear in lumbar spinal decompression and discectomy: analysis of a nationwide database. Arch Orthop Trauma Surg. 2013; 133 (11): 1501-8.
15. Papavero L, Engler N, Kothe R. Incidental durotomy in spine surgery: first aid in ten steps. Eur Spine J. 2015; 24 (9): 2077-84.
16. Bernatz JT, Anderson PA. Thirty-day readmission rates in spine surgery: systematic review and meta-analysis. Neurosurg Focus, 2015; 39 (4): E7.
17. Tsutsumimoto T, Yui M, Uehara M, Ohta H, Kosaku H, Misawa H. A prospective study of the incidence and outcomes of incidental dural tears in microendoscopic lumbar decompressive surgery. Bone Joint J. 2014; 96-b (5): 641-5.
18. Takahashi Y, Sato T, Hyodo H, et al. Incidental durotomy during lumbar spine surgery: risk factors and anatomic locations: clinical article. J Neurosurg Spine, 2013; 18 (2): 165-9.
19. Saxler G, Kramer J, Barden B, Kurt A, Pfortner J, Bernsmann K. The long-term clinical sequelae of incidental durotomy in lumbar disc surgery. Spine (Phila Pa, 1976), 2005; 30 (20): 2298-302.
20. Brookfield K, Randolph J, Eismont F, Brown M. Delayed symptoms of cerebrospinal fluid leak following lumbar decompression. Orthopedics, 2008; 31 (8): 816.
21. Endriga DT, Dimar JR, 2nd, Carreon LY. Communicating hydrocephalus, a long-term complication of dural tear during lumbar spine surgery. Eur Spine J. 2016; 25 Suppl. 1: 157-61.
22. Cain JE, Jr., Lauerman WC, Rosenthal HG, Broom MJ, Jacobs RR. The histomorphologic sequence of dural repair. Observations in the canine model. Spine (Phila Pa, 1976), 1991; 16 (8 Suppl): S319-23.

AUTHORSHIP AND CONTRIBUTION DECLARATION			
Sr.#	**Author's Full Name**	**Intellectual/Contribution to Paper in Terms of:**	
1.	**Muhammad Mukhtar Khan** (Main/Principal Author).	1. Treatment and literature review.	Signature by the author(s) 
2.	**FaiqaFilza Khan** (2nd Author)	2. Paper writing.	
3.	**Irfan Jan** (3rd Author)	3. Analysis of data and interpretation of results etc.	
4.	**Waeeem Dad Khan** (4th Author)	4. Literature review and manuscript writing	
5.	**Sohail Daud Khan** (5th Author)	5. Paper writing, referencing and data calculations	
6.	**Tariq Khan** (6th Author)	6. Study design, methodology and quality insurer.	

Date of Submission: 31-07-2019
Date of Revision: 28-08-2019
Date of Online Publishing: 25-09-2019
Date of Print: 30-09-2019