International Journal of Research in Orthopaedics
Rahman MM et al. Int J Res Orthop. 2025 Sep;11(5):991-995
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20252623

Prevalence and treatment outcomes of incidental dural tears in lumbar spine surgery

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Received: 12 March 2025
Accepted: 11 April 2025

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ABSTRACT

Background: Incidental dural tears (IDT) are common in lumbar spine surgery, varying in prevalence due to patient factors, pathology, and surgical techniques. They may cause cerebrospinal fluid leakage, headaches, and delayed recovery. Proper identification and management are essential for favorable outcomes. This study aimed to evaluate the prevalence and treatment outcomes of incidental dural tears.
Methods: This study was conducted at the Department of Orthopaedics, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) and Sylhet M.A.G. Osmani Medical College, Sylhet, Bangladesh from January 2023 to December 2024, using purposive sampling. A total of 86 patients undergoing lumbar spine surgery were included, excluding those with infections or malignancies. Incidental dural tears and treatment outcomes were analyzed using SPSS Version 23, with significance set at $p<0.05$.
Results: The prevalence of IDT in lumbar spine surgery was 15.1%. The IDT group consisted of 84.6% males, 23.1% patients aged ≤30 years, and 53.8% with previous spinal surgery. The IDT group had longer operation times (197.4±37.7 minutes), longer hospital stays (10.5±2.1 days), and higher drainage volumes (266.7±28.9 ml). Post-operative complications, including wound infections (23.1%) and headaches (30.8%), were more common in the IDT group.
Conclusions: IDT occur in 15.1% of lumbar spine surgeries. Risk factors include male gender, younger age, and previous spinal surgery. IDT is linked to longer operation times, extended hospital stays, higher drainage volumes, and increased post-operative complications.

Keywords: Headache, Incidental dural tear, Lumbar spine surgery, Vertebral fracture, Wound infection

INTRODUCTION

Incidental dural tears (IDT) are a common intraoperative complication in lumbar spine surgery, with reported prevalence rates ranging from 1% to 17% depending on patient demographics, surgical techniques, and surgeon experience.[1,2] These tears occur when the dura mater, which encases the spinal cord and cerebrospinal fluid (CSF), is unintentionally breached, potentially leading to significant postoperative complications such as cerebrospinal fluid leaks, headaches, meningitis, and pseudo meningocele formation.[3,4] Risk factors associated with IDT include advanced age, previous spine surgeries, degenerative spinal conditions, and extensive adhesions due to chronic inflammation or fibrosis.[5] Moreover, minimally invasive techniques have been associated with lower rates of dural tears compared to conventional open surgery, highlighting the importance of the surgical approach in minimizing this complication.[6] Other factors, such as surgeon experience, instrumentation, and operative

time, have also been implicated in influencing the incidence of this complication.[7] The management of IDT varies depending on the size and location of the tear. Direct primary repair using sutures, fibrin glue, or fat grafting is often performed when feasible, whereas larger defects may require dural substitutes or lumbar drains to prevent persistent CSF leakage.[8] Proper intraoperative identification and immediate repair significantly reduce postoperative morbidity and improve patient recovery outcomes.[5] Postoperative management strategies, including bed rest, external drainage, and pharmacologic measures, are often employed to prevent complications related to persistent CSF leakage.[9] Despite advancements in surgical techniques, there is no universal consensus on the optimal management approach, making it essential to evaluate the effectiveness of various repair strategies. This study aimed to assess the prevalence and treatment outcomes of IDT in lumbar spine surgery. By analyzing the incidence, risk factors, and postoperative recovery, this study contributes to the growing body of evidence guiding optimal intraoperative and postoperative management strategies for this complication. The findings will help improve patient outcomes and refine surgical techniques to minimize the occurrence and impact of IDT.

METHODS

This study was conducted at the Department of Orthopaedics, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) and Sylhet M.A.G. Osmani Medical College, Sylhet, Bangladesh from January 2023 to December 2024. A purposive sampling method was used to include 86 patients who underwent lumbar spine surgery. Inclusion criteria were patients aged 18 years or older who underwent lumbar decompression, discectomy, or fusion surgery. Patients with prior lumbar spine infections, malignancies, or incomplete medical records were excluded. The incidence of IDT was identified intraoperatively, and management strategies such as primary suturing, fibrin glue application, and dural grafting were documented. Postoperative outcomes, including cerebrospinal fluid leakage, neurological deficits, and hospital stay duration, were assessed. Data were analyzed using SPSS Version 23, with statistical significance set at $p<0.05$.

RESULTS

In this study, the overall prevalence of IDT was found to be 15.1%. The demographic analysis of 86 participants revealed that a majority were male (65.1%), with a significantly higher proportion of males in the IDT group (84.6%) compared to the non-IDT group (61.6%). Age distribution indicated that most participants were over 60 years old (31.4%), but the IDT group had a lower percentage in this age category (30.8%) compared to the non-IDT group (85.2%). The non-IDT group had a higher proportion of participants aged 31-60, while the IDT group had a higher proportion aged ≤30 years (23.1%).

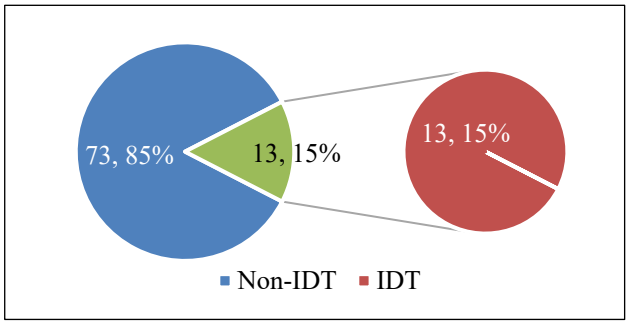

Figure 1: Prevalence of IDT in patients.

Table 1: Demographic data of participants.

Variable	Total (n=86)		Non-IDT (n=73)		IDT (n=13)	
	N	%	N	%	N	%
Age (years)						
≤30	13	15.1	10	13.7	3	23.1
31-40	11	12.8	10	90.9	1	7.7
41-50	18	20.9	15	83.3	3	23.1
51-60	17	19.8	15	88.0	2	15.4
>60	27	31.4	23	85.2	4	30.8
Gender						
Male	56	65.1	45	61.6	11	84.6
Female	30	34.9	28	38.4	2	15.4

Regarding the operation characteristics, most participants (77.9%) underwent treatment for a single lumbar level, with the non-IDT group having a higher percentage of single-level treatments (86.3%) compared to the IDT group (30.8%). The IDT group had a higher proportion of patients treated for double (46.2%) or multiple lumbar levels (46.2%) compared to the non-IDT group (4.1%). As for previous spinal surgery, 89.5% of participants had no prior surgery, but the IDT group had a significantly higher proportion with previous spinal surgery (53.8%) compared to the non-IDT group (2.7%). The most common indication for lumbar spine surgery was vertebral fracture (53.5%), with the non-IDT group having a higher

proportion of such cases (60.3%) compared to the IDT group (15.4%). Other indications included lumbar disc herniation (16.3%), more common in the IDT group (30.8%) than in the non-IDT group (13.7%), and spinal canal stenosis, which was more prevalent in the IDT group (23.1%) than the non-IDT group (16.4%). Spondylolisthesis, extradural spinal tumors, and scoliosis were less common, with scoliosis only occurring in the IDT group (7.7%).

Table 2: Prevalence of IDT based on the data of operation.

Variable	Total		Non-IDT		IDT	
	N	%	N	%	N	%
Number of lumbar levels treated						
Single	67	77.9	63	86.3	4	30.8
Double	10	11.6	7	9.6	3	23.1
Multiple	9	10.5	3	4.1	6	46.2
Previous history of spinal surgery						
No	77	89.5	71	97.3	6	46.2
Yes	9	10.5	2	2.7	7	53.8

Table 3: Prevalence of IDT based on indications of lumbar spine surgery.

Surgery indications	Total		Non-IDT		IDT	
	N	%	N	%	N	%
Vertebral fracture	46	53.5	44	60.3	2	15.4
Lumbar disc herniation	14	16.3	10	13.7	4	30.8
Spinal canal stenosis	15	17.4	12	16.4	3	23.1
Spondyloli-sthesis	7	8.1	5	6.8	2	15.4
Extradural spinal tumor	3	3.5	2	2.7	1	7.7
Scoliosis	1	1.2	0	0.0	1	7.7

Table 4: Comparative clinical outcomes.

Operation parameters	Non-IDT	IDT	P value
Operation time (minutes)	129.7±23.2	197.4 ±37.7	<0.001
Post-operative hospital stays (days)	5.8 ±1.4	10.5±2.1	<0.001
Amount of drainage (ml)	130.2±25.6	266.7±28.9	<0.001

Comparative clinical outcomes revealed significant differences between the IDT and non-IDT groups. The IDT group had a longer operation time (197.4±37.7 minutes vs. 129.7±23.2 minutes), longer post-operative hospital stays (10.5±2.1 days vs. 5.8±1.4 days), and greater drainage volume (266.7±28.9 ml vs. 130.2±25.6 ml). Complications in the IDT group included wound infections (23.1%), headaches (30.8%), nausea (15.4%), vomiting (7.7%), and low back pain (7.7%), with headaches being the most frequent complaint. These findings underline the greater surgical challenges and post-operative concerns associated with IDT.

Table 5: Complications of IDT patients.

Complications	N	%
Wound infection	3	23.1
Headache	4	30.8
Nausea	2	15.4
Vomiting	1	7.7
Low back pain	1	7.7

DISCUSSION

The prevalence of IDT in this study was 15.1%, which aligns with findings from recent studies that report a range between 10% and 20% for IDT occurrence during lumbar spine surgeries.[10,11] The demographic analysis of our study revealed a significant male predominance (84.6%) in the IDT group, consistent with other contemporary research indicating that men are at greater risk for dural tears, possibly due to anatomical factors such as more prominent vertebral structures and greater surgical intervention.[12,13] The age distribution showed that the non-IDT group had a higher proportion of older patients, particularly those over 60 years (85.2%), while the IDT group had a notably larger percentage of younger patients aged ≤30 years (23.1%). This finding is consistent with the literature suggesting that younger patients with conditions such as lumbar disc herniation and trauma may be more prone to dural tears due to the nature of these pathologies.[14] Surgical characteristics revealed that the majority of participants in the non-IDT group underwent single-level lumbar treatments (86.3%), whereas the IDT group had a higher proportion of patients with multiple lumbar levels treated. This difference corroborates findings from recent studies indicating that more complex multi-level lumbar surgeries are associated with an increased risk of dural tears, due to the extended dissection and greater manipulation of the dura and neural elements.[15,16] Additionally, a higher percentage of patients in the IDT group had a history of previous spinal surgery (53.8%), suggesting that prior surgical interventions, with their associated scarring and altered anatomy, may predispose patients to complications such as dural tears.[17,18] Regarding surgical indications, vertebral fractures were the leading cause for lumbar spine surgery in both groups, with a higher proportion in the non-IDT group (60.3%). This finding likely reflects the greater incidence of osteoporotic fractures in older populations.[19] In contrast, the IDT group had a higher prevalence of lumbar disc herniation and spinal canal stenosis, conditions that are associated with more extensive decompression procedures, which are known to increase the likelihood of dural tears due to the delicate nature of the surrounding structures.[20,21] Clinical outcomes further highlighted significant differences between the two

groups. The IDT group had longer operation times, extended post-operative hospital stays, and greater drainage volumes, all of which are consistent with recent studies demonstrating that dural tears contribute to increased operative complexity and prolonged recovery times.[22,23] Post-operative complications were also more common in the IDT group, with a notably higher incidence of wound infections (23.1%), headaches (30.8%), and nausea (15.4%). These complications are frequently reported in the literature and may be attributed to cerebrospinal fluid leakage, which complicates the healing process and increases the risk of infections and other neurological symptoms.[24,25] This study confirms that IDT are a significant complication in lumbar spine surgery, with risk factors including male gender, younger age, multiple lumbar levels treated, and previous spinal surgery. These findings highlight the need for careful surgical planning, early detection, and proactive management to minimize the impact of IDT on patient outcomes.

CONCLUSION

The IDT occur in 15.1% of lumbar spine surgeries. The risk factors for IDT include male gender, younger age, and a history of previous spinal surgery. IDT is associated with longer operation times, extended hospital stays, and higher drainage volumes. Additionally, post-operative complications such as wound infections and headaches are more prevalent in IDT patients, highlighting the increased surgical complexity and challenges in managing these cases.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rahman MM, Hannan MA, Jahan MS, Monir M. Prevalence and treatment outcomes of incidental dural tears in lumbar spine surgery. Int J Res Orthop 2025;11:991-5.