Surgical Outcomes of Intradural Extramedullary Tumor Excision- 5 Years of Experience at a Tertiary Care Center

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Introduction: Intradural extramedullary tumors (IDEM) are one of the causes of back pain and weakness of the lower extremity. Diagnosis is usually made by myelography or magnetic resonance imaging (MRI). Complete tumor excision with decompression of neural elements is one of the preferred treatment methods. However, the outcome of surgical treatment is not well investigated. Hence, this study will evaluate the outcomes of surgical treatment in patients diagnosed with IDEM.

Methods: This is a retrospective study carried out between June 2013 and May 2018 at a tertiary care center. The medical records and MRIs were reviewed for demography, types of tumor, pain score, neurological recovery, and complications. Neurology was assessed using Frankel's grade, pain using Visual analog score (VAS), and functional status using Nurick's grade.

Results: The average age of the patient was 42.9 years (range 17-64 yrs). The average follow-up was 32.8 months. The average duration of illness was 10.5 months (range 2-36 months). The thoracic region was most commonly involved. Histo-pathological analysis showed

Schwannoma in nine cases, meningioma in two cases, and myxopapillary ependymoma in one case. Three had normal neurology before and after surgery. Seven patients had Frankel D neurology and one patient had Frankel B and one patient had Frankel C neurology at presentation. All improved to Frankel E at the last follow up. Ten patients who had Nurick's grade 3 preoperatively improved to grade 1 postoperatively. Three patients underwent instrumentation, one patient developed post-op cerebrospinal fluid (CSF) leak. No recurrence was reported within the final follow-up.

Conclusion: Surgical treatment in patients with IDEM results in improvements in pain-related outcomes and neurological recovery. However, further studies with larger case series and longer follow-up duration are recommended to evaluate risks of recurrence.

Keywords: extramedullary, intradural, intra-spinal, meningioma, schwannoma, IDEM, spinal cord tumor.

Spinal tumors account for approximately 5-15% of the nervous system neoplasms. These tumors are classified as extradural (55-60%) and Intradural tumors (40-45%). Intradural tumors are further classified as intradural extramedullary and Intradural intramedullary tumors.[1] IDEM accounts for two-thirds of all primary intraspinal neoplasms including mostly schwannomas, meningiomas and ependymomas.[2,3] Most of these tumors are benign and usually occur in middle-aged people. Schwannomas and ependymomas usually affect younger age men whereas meningiomas affect elderly women.

Spinal meningiomas are mostly found in the thoracic region and are mostly seen in females most probable reason is the influence of female hormones.[4] Intradural tumors usually present with nonspecific symptoms. These tumors can also cause back pain and weakness of the lower extremity. It usually presents with radiculopathy and mild pain which is more severe during nighttime. In one of the studies, Sphincter dysfunction, paraparesis, and erectile dysfunction occurred in 20%, 12%, and 2% of patients respectively.[5] Sometimes these tumors present like a prolapsed intervertebral disc or spinal stenosis, diagnosing them can be challenging. MRI/Myelography allows making early diagnosis and accurate identification of the location of a tumor in the dura mater and its dural attachment before surgery.[6]

Sir Victor Horsley in 1888 succeeded for the first time in surgically excising an IDEM tumor located in the thoracic region, and this was 44years before the invention of myelography.[6] Even though surgical

management is widely preferred, the clinical and functional outcomes of surgery are not well investigated. Hence, we aim to investigate the surgical outcomes in patients with intradural extramedullary tumors.

Materials and Methods

This study was conducted following the guidelines of the Institutional Review Committee (IRC). Medical records of patients who underwent surgery for Spinal tumors in a tertiary care hospital between June 2013 and May 2018 were screened. Patients operated for IDEM with histological confirmation of tumor were included. All medical records demographic details, clinical charts, operative notes, and outpatient's progress and MRI was traced. The patient's age, sex, vertebral level, duration of illness, neurology at presentation, and last follow-up, histological diagnosis, and follow-up period were recorded. All patients underwent Laminectomy and tumor excision en bloc via a posterior approach to the spine irrespective of location. Three patients underwent instrumentation as facet joints had to be sacrificed due to the location of the tumor leading to instability. En Bloc resection was possible in all patients. Nerve root was preserved in all cases. Closure of dura was done with 6-0 prolene. No microscope or neuromonitoring was used for only of the cases. A negative pressure drain was used in all cases. Drain removal was done on 3rd postoperative day (POD) and then mobilization started. No braces were used postoperatively. Discharge was done on the discretion of the operating surgeon. Suture removal was done on 14th post operative day.

The patient's neurology was assessed; preoperatively and at last follow up using Frankel's grading system whereas neurological function was assessed using Nurick's grading system. Surgery was done by various members of the Spine team and not by a single surgeon. Preoperative and post-operative (at last follow-up) pain was assessed using Visual Analogue Score (VAS).[7]All patients had at least six months of follow-up **(Figure 1-3)**.

For the assessment of the preoperative neurological function, the patients' ambulation ability was graded into 5 levels according to Nurick's grading system.[8] Neurological status was assessed using Frankel scale. [9]

Continuous data were reported as mean (standard deviation) and categorical data were reported as frequency (%). Statistical analysis was done using paired t-test and the level of significance was set at 0.05. Data analysis was done using SPSS software version 20.

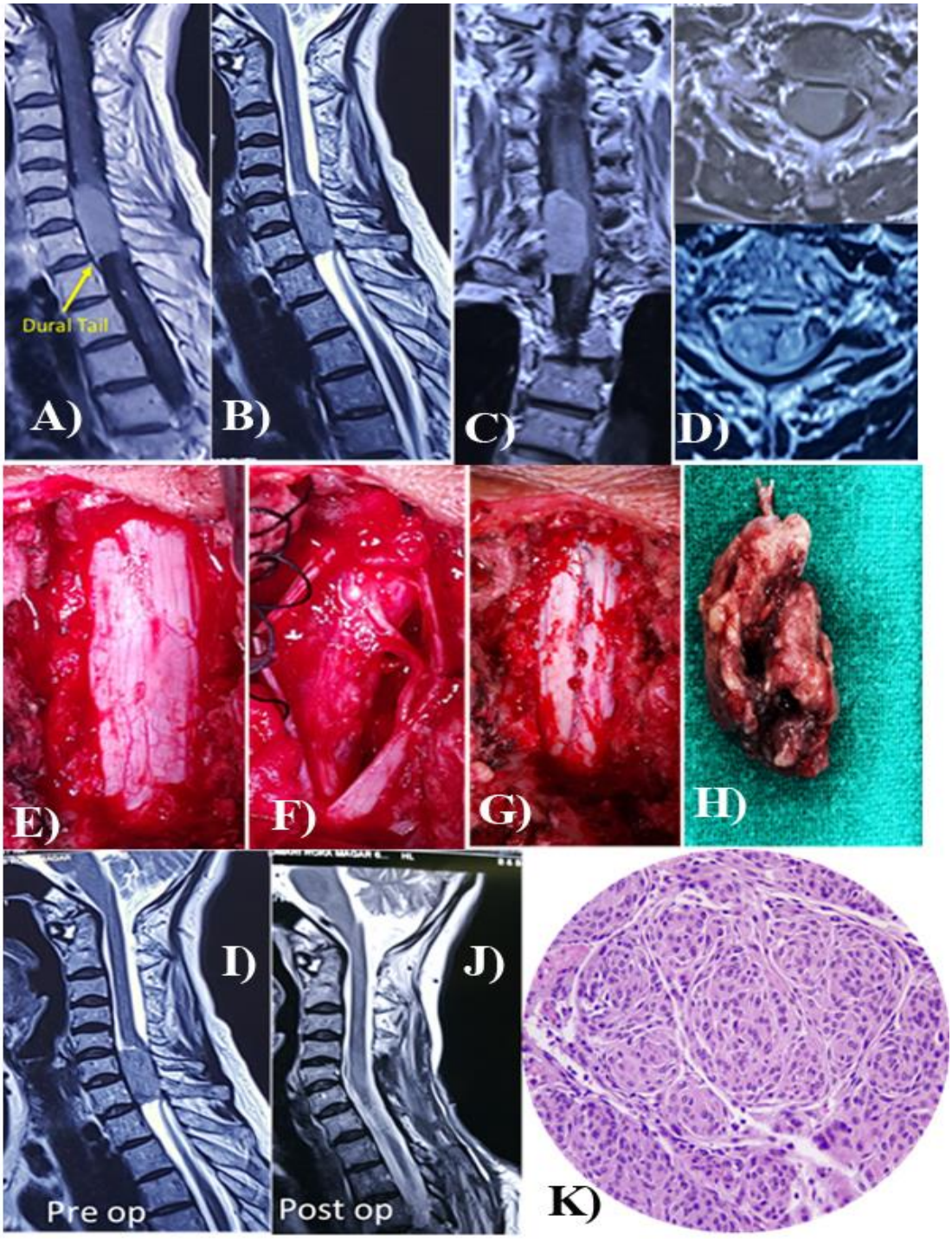

Figure 1: Meningioma: (A, B) Preoperative sagittal T1, T-2 weighted, and T1 coronal MRI showing the hypo intense lesion; (C, D) Preoperative axial T1 Weighted Image and post-contrast T-2 weighted image showing the partially enhanced tumor and severely compressed spinal cord (E-H)Intraoperatively image showing tumor resection; (I, J) Pre and Postoperative sagittal T-2 weighted MRI showing radical tumor resection); (K) Biopsy of the same lesion showing typical lobulated whorl pattern of cellular growth typical of meningioma.

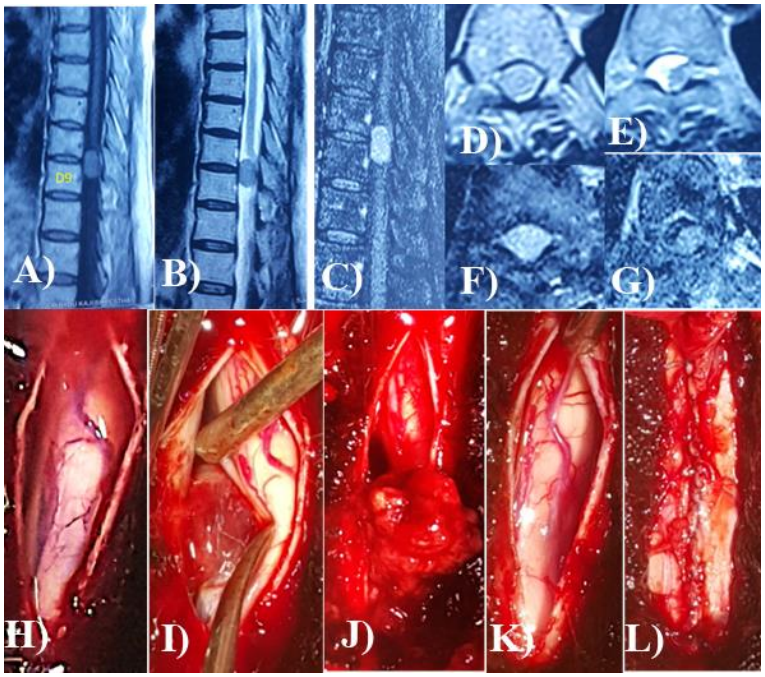

Figure 2: Meningioma: (A-C) Preoperative sagittal T1, T-2 weighted MRI showing the hypo intense tumor; (D-G) Preoperative sagittal and axial post contrast T-2 weighted image showing the partially enhanced tumor and severely compressed spinal cord (H-L) Intraoperative image showing tumor resection.

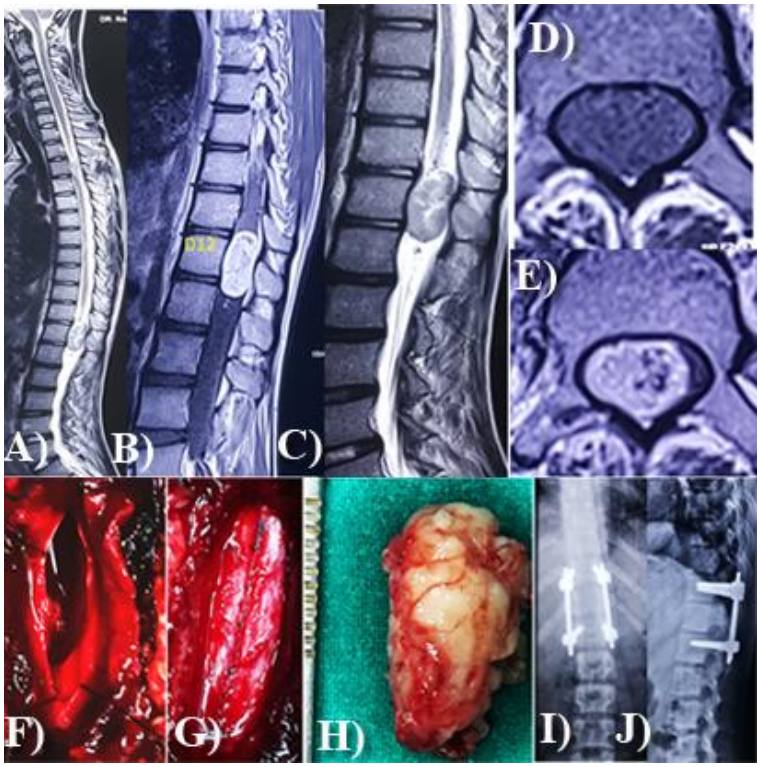

Figure 3: Schwannoma: (A-C) Preoperative sagittal T1, T-2 weighted MRI showing the hetero intense tumor; (D, E) Preoperative axial T1weightedimage and post-contrast T-2 weighted image showing the partially enhanced tumor and severely compressed spinal cord; (F-H) Intraoperative image showing tumor resection; (I, J) post op x-ray after instrumentation.

Results

31 spinal tumors were treated at the Department of orthopedics, spine unit, B & B Hospital during the period between June 2013 and May 2018. Out of which, 12 cases were intradural extramedullary tumors (38%).

The average age of the patient was 42.9 years (range 17-64 years). Follow up period was 32.8 months (range 6-48 months) on

Case	Age(in years) /Sex	Vertebral Level	Histological Diagnosis	Duration of Illness (months)	Neurology at Presentation (Frankel)	Neurology at final follow up (Frankel)	Follow up Duration (Months)
1	17/Male	Dorsal 12	Schwannoma	24	D	E	8
2	32/Male	Dorsal 12-Lumbar 2	Maxillo Papillary Ependymoma	5	D	E	12
3	48/Male	Dorsal 9-10	Schwannoma	7	D	E	48
4	22/Male	Dorsal 8-10	Schwannoma	9	D	E	48
5	40/Female	Lumbar 3-4	Schwannoma	36	E	E	7
6	60/Female	Cervical 5-7	Meningioma	3	D	E	6
7	60/Female	Dorsal 11-12	Schwannoma	13	D	E	13
8	56/Female	Dorsal 10-11	Meningioma	2	B	E	24
9.	51/Female	Lumbar 4-5	Schwannoma	12	E	E	36
10.	40/Female	Sacral 1	Schwannoma	12	E	E	48
11.	64/Female	Lumbar 1	Schwannoma	7	D	E	48
12.	25/Female	Dorsal 7-8	Schwannoma	3	C	E	48

Table 1: Demographic and Clinical Profile

Case	Visual Analogue Score(VAS)		Nurick's Grade	
	Pre Op	Last Follow up	Pre Op	Last follow up
1	6	1	3	1
2	6	2	3	1
3	7	3	3	1
4	5	1	2	1
5	6	2	3	1
6	7	3	3	1
7	8	4	3	2
8	6	1	4	1
9	7	3	3	1
10	6	2	3	1
11	6	2	3	1
12	7	2	3	1

Table 2: Clinical Symptoms

	Pre Op	Last Follow up	p-value
VAS	6.41 (0.79)	2.16 (0.93)	<0.001*

*One-tailed paired t-test, α=0.05

Table 3: Clinical Improvement

average. The mean duration of illness was 10.5 months (range 2months-36 months).Most common location of the tumor was thoracic(n= 6(50%)) followed by thoracolumbar junction(n=4 (33.3%)) and cervical (n=1(8.3%)) and sacral(n=1(8.3%)). Histo-pathological analysis showed Schwannoma (n=9(75%)), meningioma (n=2(16.5%)) and myxopapillary ependymoma in (n=1(8.5%)) cases as shown in **Table 1**. Three had normal neurology before and after surgery and seven patients had Frankel D neurology which improved to Frankel E. One patient developed a post-op cerebrospinal fluid (CSF) leak, which was managed conservatively and the patient improved.

As shown in **Table 2**, ten of twelve patients were Nurick grade 3 preoperatively and showed marked improvement postoperatively. However, one patient only improved from grade 3 to grade 2. The pain was improved in all patients who were clinically significant as shown in **Table 3**.

Discussion

Our case series had a mean age of 42.9 years. We found that schwannoma affects much younger patients than meningioma, which affects older women. The most common location was the thoracic region. This demographic finding was similar to other studies.[4,10,11] Joshi et al[10] reported meningioma as a common tumor (8 out of 19 cases) in their case series however our case series showed 9 out of 12 cases to be schwannoma.

In our study, the average duration of illness till diagnosis was 10.5 months There is a delay in making an early diagnosis, as IDEM spinal tumors tend to be slow-growing, produce vague symptoms and produce symptoms similar to intervertebral disc prolapse and spinal stenosis.[12] Hence, taking a detailed history, conducting a thorough physical examination, and performing MRI scans on the proximal regions are helpful for patients with back pain and radiating pain in the lower limbs.

In our study, the mean VAS score was reduced from 6.41 preoperatively to 2 postoperatively. This suggests that surgical treatment results in a marked reduction in pain-related symptoms. The outcome of this study is comparable to other studies [12–16] (14-16). Ahn et al[13], in 2009, showed that the mean VAS score was reduced from 8 to

1.2 after surgery. Similarly, Ahsan et al[14] reported a reduction of the mean VAS score from 7.67 to 1.14.

Most studies showed marked improvement in neurological function after surgery. Gu et al[15] in his study showed 93% of his patients had improved Frankel grade and 7% had no change. In our study, 9 patients had neuro deficit and all of them showed marked improvement at the last follow-up. Similarly, Ahn et al.[13] in their study showed a marked improvement in mean Nurick's grade after surgery. Similar findings were also seen in our study. This suggests that surgical treatment of these tumors results in an improvement in neurological functions. One of the main reasons behind that could be the benign nature of these tumors with the possibility of complete excision.[4] In our study, all patients had a tumor that was well surrounded by a capsule with a well-defined margin, and complete excision of the tumor was possible in all cases.

The prognosis of these tumors depends upon several factors, such as pre-operative duration of symptoms, the severity of neurological deficits, and proximal or ventral location.[2,6] According to Asazuma et al[17], the recurrence rate of intraspinal neoplasm was 7.2% and 46% of recurred masses were IDEM spinal tumors which recur more commonly than other intraspinal tumors. They also reported that the ventral location of a tumor, extradural invasion, neurogenic tumors, and ependymomas were the risk factors for recurrence. No recurrences were reported at last follow-up. However, a longer follow-up period is needed to substantiate the finding.

Limitations of the Study

The limitations of the study were smaller sample size and study design, i.e. retrospective study, related limitations. This suggests that there are risks of biases. Surgery was performed without using a microscope or any neurophysiological monitoring and was not done by a single spine surgeon. Only a few patients had a long follow-up period.

Conclusion

Surgical management of IDEM tumors results in a marked reduction of pain-related symptoms and improvement in neurological function as the complete excision of tumors is possible. Although the chance of recurrence is low, further study with long-term follow-up is warranted.

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Annexure

Nurick's grading system	
Grade 1	Normal walk, possible clinical spinal irritation
Grade 2	Slight difficulty in walking with normal domestic and working life
Grade 3	Functional disability limiting normal work and domestic activities
Grade 4	Significant weakness making walking impossible without help
Grade 5	Bedridden or wheelchair-bound

Frankel Scale		
Frankel A	Complete	No motor or sensory function below level of lesion
Frankel B	Sensory only	No motor function, but some sensation preserved below level of lesion
Frankel C	Motor useless	some motor function below level of lesion
Frankel D	Motor Useful	Useful motor function below level of lesion
Frankel E	Recovery	Normal motor and sensory function, may have reflex abnormalities