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Evaluation of surgical characteristics and clinical outcome of 11 patients with thoracic discectomy through transfacet approach

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Keywords
discectomy, herniation, spine, thoracal, transfacet

ABSTRACT

Background: In thoracal disc herniation (TDH) requiring surgery, the size, level, anatomic location, and calcification of the disc are extremely important in the selection of the technique to be applied. Since the thoracic region does not allow spinal cord manipulation, the surgery is difficult and requires experience. A consecutive series of patients who underwent thoracic discectomy through a posterior transfacet approach is presented in this study.

Methods: Eleven patients (6 men, and 5 women) underwent surgery at 12 disc levels. The mean age was 53.54 years (range 28-72 years). Patients presented with myelopathy (n = 8, 73%), radiculopathy (n = 7, 64%), back pain (n =10, 91%), and urinary dysfunction (n = 6, 55%). Seven (58%) lateral, 3 (25%) calcified, and 4 (33%) large disc herniations were revealed by preoperative imaging. The mean follow-up period was 21.02 ± 8.04 months (range 6 – 43 months).

Results: A posterior transfacet approach was used for all eleven patients with TDH. Thoracic discectomy was performed at T11- 12 (36%) level for 4 patients, and equally at T10- 11 (36%) level for the other 4 patients. A bilateral approach with laminotomy was performed in one patient, and a two-level discectomy was performed in another patient. Unilateral partial laminectomy was added for 3 patients. The average operating time was 146.85 minutes (range 125-220 minutes). The average hospital stay was 4.2 days (range, 2- 13 days) while no neurological functional deterioration was observed in any of the patients after surgery. Postoperative 1-month and 6-month ODI scores were found significantly different from preoperative ODI scores in all patients.

Conclusions: Thoracal discectomy through the posterior transfacet approach route is a safe and effective technique to achieve adequate decompression without requiring instrumented fusion.

INTRODUCTION

Surgical treatment of symptomatic thoracal disc herniation (TDH) is a major challenge for spine surgeons because the thoracic spine is not suitable for manipulation. The main problem of thoracic disc surgery is the lack of a “gold standard” surgical technique to be applied. Total

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laminectomy, which was performed for a period, has been abandoned today as a result of severe complications (15, 21, 26). Recently, advanced techniques for the treatment of TDH, including the transpedicular, microsurgical pedicle-sparing transfacet, costotransversectomy, lateral extracavitary, transthoracic, and thoracoscopic approaches have been used in different centers (1, 8, 15, 18, 20, 24, 25, 27, 31, 36). Each technique has particular disadvantages and potential complications. Ultimately, the goal of any of these procedures is to reduce the patients' pain, improve their quality of life, and improve their neurological status with limited morbidity.

This study presents a consecutive series of surgically excised TDH through a posterior transfacet approach. The goal was to assess the outcomes and complications in patients undergoing transfacet discectomy.

Materials and Methods

Patient Characteristics and Operative Indications

Eleven patients with symptomatic extradural TDH surgically treated by a single surgeon between January 2010 and January 2016 were analyzed clinically, radiologically, and surgically. Ethical approval was obtained from the ethical committee and written informed consent was obtained from participants in the study before surgery. Six men and 5 women (mean age; 53.54 years, range 28-72 years) were included, with surgery performed at 12 disc levels (Table 1). History and neurologic examination were obtained at the initial presentation and follow-ups. Indications for surgery included myelopathy, radiculopathy, and urinary dysfunction. Patients with isolated back pain without neurologic symptoms were not considered for surgical intervention. All patients underwent preoperative spinal magnetic resonance (MR) and computed tomographic (CT) imaging. Imaging studies were reviewed for assessment of calcification, location relative to midline, and size of disc herniation. The size of disc herniation was classified into three groups: small (0-10% canal occupation), medium (10-20% canal occupation), and large (>20% canal occupation).

Operative parameters including surgical time, estimated blood loss, the length of hospital stay, and complications were tabulated from the available record. The standardized Oswestry Disability Index (ODI) questionnaire (23) was used to determine the disability of the patients preoperatively and postoperatively 1 month and 6 months. SPSS 21 (Statistical Package for Social Sciences) for Windows Software was used for the evaluation of the findings. A p-value less than 0.05 was considered statistically significant. The paired t-test was used for the comparison.

Surgical Technique and Operative Data

A posterior transfacet approach was used for all patients. A midline skin incision was used in all of the 11 patients. Of those,10 patients underwent a unilateral subperiosteal approach with bony decompression. One patient with a large central TDH and severe cord compression had undergone bilateral exposure with laminectomy before attempting discectomy.

Patients were positioned prone on the operating table following induction of general anesthesia and endotracheal intubation. Intra-operative spinal cord monitoring was utilized in six patients (patients number 4, 7, 8, 9, 10, 11) while the remaining five did not have any spinal cord monitoring during the procedure. The incision was marked using lateral C-arm fluoroscopy. After a 4-cm midline skin incision centered over the disc space, posterior vertebral elements were exposed in standard fashion out laterally to the transverse processes using a subperiosteal dissection. The surgical level was confirmed intraoperatively with fluoroscopy on the transverse process overlying the disc of interest. The facet complex is partially removed with a high-speed drill under the operative microscope. This proceeded through a limited unilateral laminotomy with medial facetectomy. The foraminal soft tissue is coagulated using bipolar cautery and the lateral annulus is exposed. Following exposure of the disc space lateral to the thecal sac, focal posterolateral soft disc herniations were removed, working in a lateral to the medial direction to create a central cavity. For large midline calcified TDH, a small trough was additionally drilled into the adjacent vertebral bodies, and the cavitation was extended medially through the disc space and adjacent endplates to undermine the herniation. The herniated disc material is decompressed into the disc cavity by using angled microrongeurs, nerve hooks, and reverse-angle microcurettes. The microscope is angulated medially and the patient is tilted contralaterally to allow visualization across the midline. The disc fragments

were then removed cautiously with curettes and pituitary forceps to achieve adequate decompression. Suction drains are not routinely placed. An exercise program is started one week after discharge to strengthen the paravertebral muscles and the patient is advised to return to daily activities.

Results

Preoperative Findings

The mean time from symptom onset to surgical decompression was 22.6 months (range, 1-54 months). Eight (73%) patients presented with myelopathy, 7 (64%) with radiculopathy, 6 (55%) with urinary dysfunction, and 10 (91%) with axial back pain. Preoperative magnetic resonance and computed tomographic imaging showed 2 small (17%), 6 medium (50%), and 4 large (33%) discs. The majority of cases were lateral disc prolapses (n = 7, 58%), with 3 centrolateral (25%) and 2 centrally (17%) located. Five cases were soft disc prolapses (42%), 3 were calcified (25%), and 4 were partially calcified (33%) (Table1).

Table 1. Sex ratio of patients

Patient	Age/Gender	Duration of Symptoms (months)	Presenting Symptoms	Level	Axial Location	Size	Calcification	Approach
1	55/M	22	BP, M, R	T10-11	L	Medium	Calcified	TF + pL
2	67/M	39	BP, M, R, U	T11-12	CL	Large	Partial	Bilateral TF + L + Fusion
3	52/F	14	BP, R	T11-12	L	Small	Soft	TF
4	28/M	6	BP, M, R, U	T10-11	C	Large	Soft	TF
5	63/F	45	BP, M, U	T8-9	CL	Medium	Calcified	TF + pL
6	46/F	42	BP, M	T11-12	L	Small	Soft	TF
7	72/M	24	BP, M, R, U	T9-10 T10-11	CL L	Medium Medium	Calcified Partial	TF + pL TF
8	49/F	1	BP, U	T11-12	C	Large	Partial	TF
9	54/M	18	M, R	T10-11	L	Medium	Soft	TF
10	37/M	11	BP, M, R, U	T9-10	L	Large	Soft	TF
11	66/F	27	BP, M	T8-9	L	Medium	Partial	TF

Surgical Findings and Functional Outcomes

Eleven patients underwent a total of 12 operated disc levels. Figure 1 illustrates preoperative and postoperative imaging for a selection of typical cases from the series. Ten patients underwent surgery on a single level, one of those (patient 2) had a large centrolateral TDH with severe cord compression and underwent a bilateral transfacet approach with bilateral laminotomy before attempting discectomy. Interbody autograft bone fusion was added to that patient. Two-level discectomy was performed in one of the patients (patient 7) while unilateral partial laminectomy was added for 3 patients (patients 1, 5, 7). The average operating time was 146.85 minutes (range, 125-220 minutes). The average blood loss was 580 ml (range, 150-1200 ml) (Table 2). Neurophysiological status was monitored via SSEP and MEP testing intraoperatively with no deterioration in signals noted in any of the 6 patients. One patient (patient 9) required a second operation for a TDH at a different level on the contralateral side 25 months after the first surgery.

There were no cases of neurological deterioration after surgery, and there were no major complications and no wrong-level surgeries in this series. A dural tear occurred in one patient who had

a calcified centrolateral disc herniation (patient 5). The dural tear was repaired with primary suture and fibrin sealant, and it healed without complication.

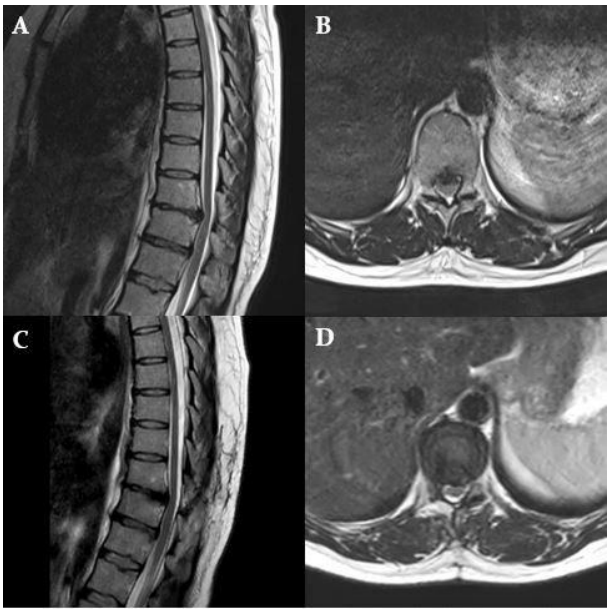

Figure 1. Sagittal (A) and axial (B) preoperative T2-weighted MR images of T8-9 disc herniation with cord compression. Sagittal (C) and axial (D) postoperative T2-weighted MR images after decompression with discectomy through the unilateral transfacet approach.

Table 2. Operative data of the patients

Operative Data	
Average operating time (minutes)	146.85 (range 125-220)
Average blood loss (ml)	580 (range 150-1200)
Average hospital stay (days)	4.2 (range 2- 13)
Mean follow-up period (months)	21.02 ± 8.04 (range 6 – 43)

The average hospital stay was 4.2 days (range 2- 13 days). The mean follow-up period was 21.02 ± 8.04 months (range 6 – 43 months) (Table 2). The ODI scores decreased significantly in both 1-month and 6-month follow-up evaluations from a mean preoperative score of 42.44 ± 11.38 to 27.46% ± 7.44% ($p<0.05$) and 24.16% ± 6.48% ($p<0.05$), respectively. No postoperative instability was developed requiring an instrumentation-assisted secondary fusion.

Discussion

In spine surgeons' practice, symptomatic thoracic disc herniation is a relatively rare pathology among spinal disc herniations. Appropriate surgical management of this rare pathology continues to be a subject of clinical studies. There have been several surgical techniques and various approaches for the treatment of TDH. The features of the herniated material, comorbidities of the patient, and the experience of the surgeon are primarily important factors in selecting an approach. Furthermore, severe neurological symptoms and the presence of spinal deformity should be considered while deciding on the technique. In the present series of transfacet approaches for thoracic discectomy, we noted functional improvement with significantly decreased ODI scores, relief of radicular pain, and no major complications. A two-level approach was used in one of these cases without difficulty. It was previously reported that in the rare occurrence of multiple disc herniations, multilevel discectomies via the transfacet approach may be performed (10). Any further surgery on the operated thoracic region was required by any patients in the series.

Thoracic discectomy using the transfacet pedicle-sparing approach was first described by Stillerman et al. in 1995, in which the lateral articular process is excised to reach the intervertebral disc (35). This method avoids the risk of neurological injury caused by intraoperative traction of the dural sac. The interference to the dural sac is minimal during exposure and the herniated disc can be well exposed for complete excision. Diminished operative time, decreased blood loss, limited bone removal, and limited soft-tissue disruption are the main advantages of this procedure. Compared with the transpedicular discectomy, less postoperative localized axial back pain was seen due to the preservation of the pedicle. Moreover, shortened hospital stays and earlier return to work give an advantage over the transthoracic and lateral extracavitary approaches. They recommended the transfacet approach for the surgical management of all soft symptomatic herniations, lateral calcified, and selected centrolateral calcified thoracic discs (35).

The transfacet approach is comparable with the other posterolateral procedures concerning the surgical trajectory and the relatively small amount of bone removal. One advantage of this approach is that the pedicle and most of the facet joints are preserved. In cases of calcified disc extension caudal to the disc space, the superomedial pedicle cortical wall resection favored greater access (35). The

inferomedial cortical wall of the pedicle, the transverse process, and related rib are preserved to protect the nerve root. It is suggested that the incidence of long-term localized pain secondary to loss of mechanical integrity will be reduced with this transfacet approach (35). There is no common consensus on the requirement for instrumented fusion after a thoracic discectomy. Some authors claim anterolateral and more extensive posterolateral techniques need instrumented fusion more commonly than the posterior unilateral transfacet approaches (19, 37). Patients with an intact unilateral facet, or >50% of facets remaining bilaterally, were considered stable by other clinical reviews reporting that fusion is uncommonly required (20, 22, 24). Although some authors have argued for the importance of an intact bilateral facet complex for stability (7, 29), others report relatively minor destabilizing effects of total facetectomy (12, 34). In the current series, evidence of preexisting segmental instability was not seen in any case. Interbody autograft bone fusion following discectomy via bilateral transfacet approach with bilateral laminotomy was performed on one patient (patient 2) who had a large centrolateral TDH. We also recognize that the addition of a partial laminectomy without instrumentation in 3 cases does not induce spinal instability at the related segment in the follow-up period.

There were several thoracal discectomy reports evaluating blood loss, operating time, the length of hospital stay, and ODI scores in the literature (7, 9, 34, 38). In the study of Sivakumaran et al., the average operating time was found 125 minutes for 24 patients who had transfacet and transpedicular approaches for thoracic discectomy (34). The mean hospital stay was found to be 3.3 days (2-10 days) when they excluded 3 patients who needed care of sociorehabilitative service because of significant preoperative neurologic dysfunction. Bransford et al. reported their experience with thoracic discectomy using a modified transfacet pedicle-sparing decompression and fusion (7). In this 16-case series, the length of postoperative hospital stay ranged from 3–11 days (mean 4.2 days) when they excluded 2 patients because of wound infections that lengthened the hospital stay. The average estimated blood loss was found to be 870 ml (range 150–3000 ml). In the study of Carr et al., the average blood loss of thoracic discectomy via posterior unilateral modified transfacet pedicle–sparing decompression with segmental instrumentation and interbody fusion was found at 770 mL (range 25-2000 mL) for 32 operations (9). Yüce et al. reported their 23 patients who had thoracic microdiscectomy with bilateral decompression via a unilateral approach.

The ODI scores of the patients significantly decreased from a mean preoperative score of 43,86 ± 8,73 to 26,52 ± 7,11 in early postoperative and 25,91 ± 6,78 at 12 (late) months ($p < 0,05$) (38). Some reports were on the comparison of anterior and posterior approaches (3, 30). Oltulu et al. reported significantly improved postoperative ODI scores of the patients with thoracic discectomy via posterior approach ($p < 0.05$) while the anterior group remained stable ($p>0.05$) (30). They found that the mean blood loss was 390.88 ml (range 50-2000 ml) for the anterior group (68 patients), 602.78 ml (range 25-2550 ml) for the posterior group (18 patients) ($p = 0.983$). Arts et al. compared the results of the anterior approach (56 patients) and the posterior approach (44 patients) (3). The average duration of the surgery through the posterior approach was 98 minutes (no stabilization done), while it was 229 minutes through the anterior approach. Blood loss in the anterior procedure was 1157 ml, and in the posterior one, it was 213 ml. The average hospitalization of patients treated through the anterior approach was markedly longer (10.1 days) than the posterior one with an average hospitalization of 4.9 days.

In this series, there are no giant thoracal disc herniations as those occupying more than 40% of the spinal canal based on preoperative imaging. These giant thoracic discs have a unique clinical presentation, surgical considerations, and outcomes as compared to smaller size TDHs. A giant calcified central TDH increases the risk of intradural extension due to erosion and progressive thinning of the dura thus making its excision more difficult and more prone to surgical complications (4, 16, 28, 32). Generally, a transthoracic approach is preferred to gain excellent exposure to the ventral aspect of the spinal canal without the need for manipulation of the dura. Thus, ventral dural access and direct repair of the defect can be possible with this approach (7, 13, 14). Thoracoscopic discectomy may be another choice for central disc herniations with the advantage of reducing morbidity (5, 11, 17). The primary disadvantage of the transfacet approach is

that opening the dura for the removal of an intradural disc fragment may not be possible because of inadequate direct ventral visualization (6, 34, 35). There was no obvious intradural penetration found in the present series.

Results of the newer minimally invasive techniques using tubular or endoscopic systems for thoracic disc resection, such as posterior and posterolateral approaches demonstrate significant improvements in pain relief, neurological outcomes, and postoperative spinal stability (2, 5). In some studies, endoscopy-assisted thoracic discectomy via posterior approaches was found useful for visualizing the ventral dura (20, 33, 35).

This study is limited by a few factors. This study has a small series of patients who underwent surgery by a single surgeon at a single institution. Another limitation is the analysis of the data in a retrospective manner rather than a prospective one. Despite the retrospective nature of this report, the efficacy and safety of the procedure are confirmed by the symptomatic improvement of the patients without concomitant morbidity. Further studies should focus on late collapse, mechanical back pain, and re-herniation in long-term follow-up of the patients who underwent a transfacet approach for thoracic discectomy.

Conclusion

While deciding on thoracic discectomy, it is necessary to know spinal biomechanics and the surgical techniques very well with their advantages and disadvantages. The study presents a single surgeon's experience with the thoracic discectomy via the transfacet approach with the results of a significant symptomatic improvement and no major complications. For the treatment of thoracal disc herniated patients with myelopathy, radiculopathy, and back pain, thoracal discectomy through the posterior transfacet approach route is a safe and effective technique to achieve adequate decompression without requiring instrumented fusion.

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