

Mini-Thoracotomy or Thoracoscopic Treatment for Medially Located Thoracic Herniated Disc?

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Study Design. A retrospective cohort study.

Objective. Comparison of the mini-thoracotomy (mini-TTA) and thoracoscopy for the treatment of calcified thoracic herniated disc.

Summary of Background Data. Thoracoscopy has been popularized at the cost of the traditional thoracotomy for the treatment of calcified herniated discs. However, the learning curve is steep. Given the low incidence of herniated thoracic discs, it will be difficult for a group of spinal surgeons to gain experience. Newer, minimally invasive techniques with a nearly absent learning curve are evolving. One of these techniques is the mini-TTA.

Methods. Retrospectively, the charts of patients that underwent a mini-TTA or thoracoscopy were retrieved.

Results. Seven patients underwent a thoracoscopy, and 21 a mini-TTA. Although the groups are limited, a statistical significant difference in gender, age, duration of surgery, duration of the necessity of a chest drain, intraoperative blood loss, or duration of the postoperative stay on the intensive care unit was not reached. At the last follow-up in the thoracoscopic group, 2 patients had some neuropathic thoracic incisional pain. In all patients, a complete removal of the calcified disc was ascertained with a postoperative computed tomography scan.

Conclusion. The mini-TTA has some theoretical advantages over a thoracoscopy. It is also a minimally invasive approach. The thoracoscopy has a steep learning curve, whereas the mini-TTA is simple to apply. Classic microsurgical bimanual techniques can be used.

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pense of the extensive open thoracic or thoraco-lumbar approach in cases of thoracic or thoracolumbar disc herniations.¹⁻³ In this report, the authors present their (although limited) experience with the thoracoscopic approach and the open transthoracic approach through a mini-transthoracic approach (mini-TTA) as described before.⁴ The advantages and disadvantages of both procedures will be discussed.

Materials and Methods

Retrospectively, data were retrieved from all patients with a thoracic disc herniation that underwent a minimally invasive approach by thoracoscopy or mini-TTA since 2004 (The Hague) respectively since 2001 (Nijmegen). Data collected include the preoperative clinical situation, the level of the herniation, calcification of the herniated disc, intradural extension of the herniated disc, duration of the surgical procedure, blood loss, intraoperative complications, data about the chest tube and the stay on the intensive care unit, postoperative degree of recovery, and complications.

Surgical Procedure. After administering general anesthesia using a double-lumen tube, for a thoracoscopic as well as for a mini-open procedure, the patient is placed in a lateral decubitus position. In lesions presenting above T 11, single-lung ventilation is used and if necessary where lesions occur below T11.

The side of operation (upper side of patient) is chosen based on the surgeon preference, and especially influenced by the level and characteristics of the herniated disc in relation to the major vascular structures to the spine.

The incisions for the portals are made under fluoroscopic guidance. The portals are placed as previously described.¹ Just before the parietal pleura is opened in both procedures, single-lung ventilation is applied. Then with the use of instruments and an adapted high-speed drill, the disc herniation is removed.

In the case of a mini-open procedure, the application of the retractor is straightforward.⁴ After identification and marking the target level on the skin, a 4- to 6-cm incision parallel to the orientation of the rib is made. The underlying rib is identified and exposed subperiosteally. Depending on the elasticity of the ribs, the rib is either partially resected or elevated with the retractor. In this series, the rib was resected in all cases. A specially designed retractor with a disposable and inflatable lung retractor (Aesculap B.V., Boxtel, the Netherlands) is inserted, leaving the spine clearly exposed. Through a classic microsurgical procedure with standard or purposely designed instruments and a standard high-speed drill, the herniated disc is removed. After removal of the herniated disc and inspection of the dura, any eventual leakage is attended to. After inspection of the reexpanded lung, a chest drain is placed. The wound is carefully closed in layers.

When a dural perforation occurs, an external lumbar cerebrospinal fluid (CSF) drain is placed and left *in situ* for approximately 5 days. However, in cases of a primary secure dural closure, an

Thoracic herniated discs are infrequently seen. They cause either radicular, myelopathic signs and symptoms, or a combination of both. The presence of the spinal cord does warrant an anterior route if the herniation is located medially or is extended laterally to the midline. Because of the calcification and the median extension, mobilization of the spinal cord is inadvertently required when a posterior route is opted for. Here the risk of neurologic complications increases dramatically. In recent years, the thoracoscopic treatment has been popularized at the ex-

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Table 1. Characteristics of Patients That Underwent Mini-TTA and Thoracoscopy for Herniated Thoracic Disc

	Mini-TA	Thoracoscopy	P
No. of patients	21	7	
Sex (female/male ratio)	12/9	5/2	0.576
Age	58.8 ± 11.3	54.8 ± 7.5	0.250
Duration surgery (min)	222 ± 87	315 ± 96	0.968
Blood loss (mL)	732 ± 960	365 ± 177	0.168
Duration chest tube (days)	1.76 ± 0.9	2.4 ± 1.3	0.139
Duration stay on intensive care (days)	1.14 ± 0.4	1.29 ± 1.1	0.602
Last follow-up (yr)	0.53 ± 0.49	1.1 ± 1.1	0.005

external lumbar drain is not required. The patients recover after surgery on the intensive care unit. Suction is placed on the chest tube (10 cm H₂O) for 12 hours, after which suction is relieved. If production of the chest tube is less than 100 mL in the previous 24 hours, it is removed and the patients are mobilized.

Statistical Analysis. Statistical analysis was performed using SPSS 11.5. Unpaired Student *t* test is used for comparison of parametric data; otherwise, χ^2 analysis, Fisher exact test, or Mann-Whitney *U* test. All tests were 2-sided. Significance is reached when $P < 0.05$. All values are described as mean (SD) unless stated otherwise.

Results

The charts of 28 patients were retrieved. Seven underwent a thoracoscopy, and 21 a mini-TTA. During this 2-year period, classic extended approaches were not performed for thoracic disc herniations.

Baseline characteristics are represented in Table 1. The distribution of the levels of the disc herniations is represented in Table 2. All patients presented with a disturbance of gait due to myelopathic changes. Two patients (1 of the mini-TTA group) also had radicular pain. In all cases, the signs and symptoms were due to a partly or completely calcified thoracic herniated disc. In 2 patients, 2 levels were affected, making a total of 30 thoracic herniated discs. Preoperative and postoperative Frankel grading is depicted in Table 3.

The values for the duration of the surgery, the intraoperative blood loss, the duration of the postoperative care on the intensive care unit, the duration of the chest drain *in*

Table 2. Involved Levels Among the Different Treatment Groups

Level	Mini-TTA	Thoracoscopy
T5–T6	1*	0
T6–T7	3*	0
T7–T8	2	1
T8–T9	1	2†
T9–T10	3	3†
T10–T11	4	1
T11–T12	8	1
Total	22	8

*One patient had on both levels a herniated disc.

†One patient had on both levels a herniated disc.

Table 3. Preoperative and Postoperative Grading for Patients With Thoracoscopy and Mini-TTA, and P Values After Testing Difference

Frankel Grade	Preoperative		6 Weeks Postoperatively		At Last Follow-up	
	Thoracoscopy	Mini-TTA	Thoracoscopy	Mini-TTA	Thoracoscopy	Mini-TTA
A	0	0	0	0	0	0
B	0	3	0	1	0	0
C	1	7	0	1	0	1
D	6	9	4	6	3	1
E	0	2	3	13	4	19
Total	7	21	7	21	7	21
P	0.242		0.545		0.067	

situ, and the duration of the follow-up are also shown in Table 1. None of the items reached statistical significance.

In 3 cases treated by the mini-TTA approach, a major part of the vertebral body was resected to safely remove the herniated disc. In these cases, an additional anterior instrumentation was performed.

In 3 patients (1 of the thoracoscopy group), the herniated disc was intradurally extended. The 1 patient that underwent thoracoscopy developed a CSF leakage warranting external lumbar CSF drainage for 7 days (Table 4). In 2 patients of the mini-TTA group, the dura was closed directly. Leakage did not occur.

In all cases, a postoperative computed tomography (CT) scan disclosed a complete resection of the lesion and decompression of the spinal cord (Figure 1). At the last follow-up, in all cases, the neurologic examination was either improved or normal (Table 3). One patient of the thoracoscopy group died 4 years after the surgery, due to problems unrelated to the thoracic herniated disc or approach. One of the patients had a normal examination, although she had a severe worsening of the symptomatology directly postoperative. Before surgery, she had a diminished strength in both legs. After a thoracoscopic removal of a large intradural calcified disc, she became paraplegic. She recovered to nearly normal following an intensive rehabilitation program, leaving some areas of altered sensations and pain at the incision. This did not affect daily life. Two patients belonging to the thoracoscopy group complained of neuropathic pain at the place of the incision. The difference did not reach statistical significance ($P = 0.056$).

Table 4. Intraoperative and Postoperative Complications

	Thoracoscopy	Mini-TTA
Intraoperative dura leakage	1*	2†
Temporary neurologic impairment	1	0
Neuropathic pain at incision at last follow-up	2	0

*Necessitating external CSF lumbar drainage of 7 days.

†Direct closure possible.

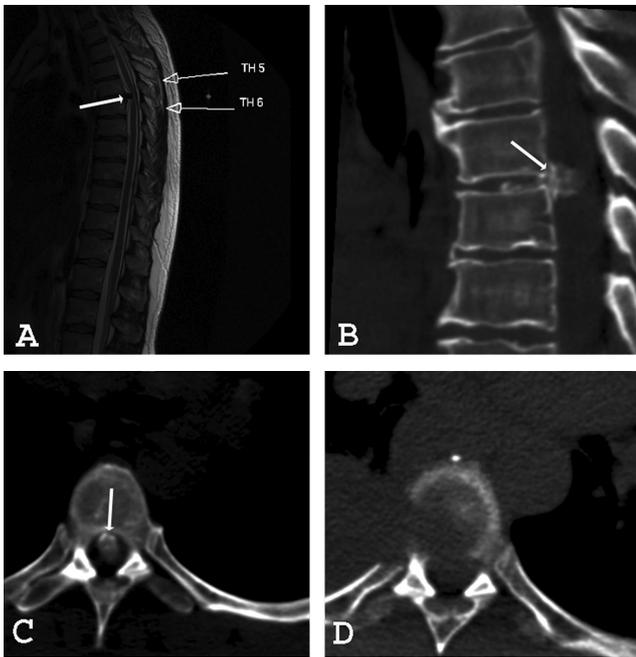


Figure 1. Sagittal T2-weighted MRI disclosing a median herniated disc at T5–T6 (A), and calcification at sagittal CT (B) as well as on the transversal CT (C) (white arrow). D, At the postoperative transversal CT, a complete removal of the calcified herniated disc was seen. The right-sided partial corpectomy defect is also clearly seen.

■ Discussion

Recently, thoracoscopic treatment for a thoracic herniated disc has been popularized at the cost of classic open thoracotomy or extensive dorsolateral approaches. The minimally invasive character of thoracoscopy is a major advantage. It induces less trauma to the patient, contributing to less incisional pain and a shorter stay on the intensive care unit. Additional benefits are better cosmetic results, earlier mobilization, and faster recovery.

A major disadvantage of thoracoscopy is the steep learning curve.^{1–3} Furthermore, to preserve the skills one has to perform this form of surgery on a regular basis, which can be difficult given the low prevalence of thoracic herniated discs. Therefore, it is unlikely that more than 1 person will obtain and maintain experience in a neurosurgical center (in the Netherlands). This is troublesome in emergency cases suffering from progressive myelopathy presenting when the surgeon familiar with the procedure is absent.

Apart from the surgical skills, the extra investment for thoracoscopic equipment and instruments may be problematic, especially in this era when proof of cost-effectiveness is warranted. Audiovisual equipment can often be borrowed from the laparoscopic surgeons. However, the instruments are specifically designed for thoracoscopy and are not the standard neurosurgical equipment.

A mini-thoracotomy using a spreader like the one developed by Michael Mayer⁴ has multiple advantages when comparing a classic thoracotomy and a thoracoscopic procedure. Although most neurosurgeons are un-

familiar with opening the thorax, this is straightforward and the learning curve is certainly not steep. It is similar to the recently reported minimal access spinal surgery approach for vertebral metastasis.⁵ If one does not prefer opening the thorax or if the patient had previous chest surgery, a general or thoracic surgeon is asked. The opening is completed within a few minutes, and the incision is about 4 to 6 cm long (it is about the same as the total length of the incision for the portals). If necessary, a part of the rib can be excised or it can be lifted depending on the laxity of the thorax.⁴ From then, the surgical route is rather straightforward assuming anatomic knowledge. More importantly, the surgical technique is very familiar for neurosurgeons: classic microsurgery with familiar bayoneted instruments under direct microscopic sight instead of operating with chopsticks as one of our laparoscopic surgeons called scopic surgery. Therefore, more surgeons within one group can perform this surgery.

Closing the dura is similar to other neurosurgical procedures; and if necessary, additional anterior body screw fixation can easily be performed through the same thoracic opening. Using a standard technique, in our patients, the dura was directly and very effectively closed with a dura substitute.

Although our experience is limited, the patients treated with a mini-TTA did not fare any worse than those treated by thoracoscopy. Indeed, a large intradural calcified herniated disc was safely removed using standard neurosurgical technique with adequate direct closing of the dura. This is in accordance with a recent report.⁶ In our opinion, thoracoscopy does not have any advantage over a mini-TTA.

In our opinion, the relatively short follow-up is not important because the effect for both procedures was the same: removal of the thoracic disc herniation and decompression of the spinal cord. This was established in all cases. Recovery of the myelopathic signs or symptoms will not be affected whether the disc is removed by either method. Therefore, the outcome will not differ between the 2 methods in the end.

The availability for mini-TTA exceeds that for thoracoscopy. If we can perform a minimal procedure extrapleurally as has been described in 1993, a chest tube is definitely not warranted.⁷ This would resemble a modified costotransversectomy through a small incision; and presumably, it would make thoracoscopic procedures for a medially located thoracic disc herniation less favorable.

■ Key Points

- A minimal transthoracic approach (mini-TTA) for a calcified herniated disc is a minimally invasive technique.
- A mini-TTA has the same outcome as an thoracoscopic removal of a disc herniation.
- The technique of a mini-TTA concurs favorably with a thoracoscopic approach.

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