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ORIGINAL STUDY

Experience of surgical treatment via posterior approaches for herniated thoracic disc

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The incidence of symptomatic herniated thoracic disc (HTD) is very low. There are still no established priority in surgical approaches and guidelines for additional instrumentation with fusion.
From 2007 through 2014, 38 patients (22 males and 16 females) were enrolled. The thoracolumbar region was a most common site for HTD (75.6%). The clinical characteristics of HTD based on size, location, and calcification; the factors for applying instrumentation with fusion were analyzed retrospectively.
All patients were undergone surgical treatment via various posterior approaches. The additional instrumentation with fusion was performed in 14 patients (36.8%). The larger amount of facet joint resection (more than 50%) was only statistical significant factor for instrumentation (p=0.023). There were four surgical complications (10.5%).
Surgical treatment via posterior approach was a reliable modality for HTD. The significant factor for applying additional instrumentation with fusion was the amount of facet joint resection.

Keywords: Thoracic disc herniation ; Surgical strategy ; Posterior approach ; Complication.

INTRODUCTION

Herniated thoracic discs (HTDs) make up less than 1% of all spinal herniated discs, with an estimated annual incidence of one per million people *(1,3,10)*. HTD affects men more frequently than women, with a peak age of onset at 40–50 years *(1)*. Approximately 75% of symptomatic HTDs involve the lower thoracic segments, with vertebrae T11–12 exhibiting the highest propensity *(3)*. HTD may present with various symptoms. The neurological symptoms resulting from thoracic disorders are sometimes misdiagnosed as cervical or lumbar disorders *(21)*. The vagueness of clinical history, chronic presentation, and other misidentified pathological processes can delay diagnosis and treatment *(23)*. Misdiagnosis can lead to a prolonged preoperative disease duration, which can cause irreversible neurological damage and even unnecessary surgical procedures *(20)*.

Surgical method is considered as treatment of choice for symptomatic HTD, especially for patients with myelopathy resulting from cord compression *(23)*. Surgical removal of HTD is relatively risky, because of the unique features of the thoracic spine such as the thicker cord diameter within the spinal

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canal and its vulnerability to ischemic injury *(13,23)*. From these reasons, a variety of surgical approaches for HTD have been reported in the literature. These approaches can be divided into two categories, anterior and posterior approaches. However, there is still no gold standard and each technique has unique advantages and disadvantages.

In this retrospective study, we analyzed 38 patients who underwent surgical treatment via various posterior approaches for HTDs to determine the feasibility and safety of posterior approaches.

MATERIALS AND METHODS

From 2007 through 2014, 38 patients (22 males and 16 females, mean 61.84 ± 12.78 years old) who underwent a surgical treatment via posterior approaches for symptomatic HTDs at a single institute were enrolled. The HTDs were noted on magnetic resonance (MR) imaging with compressing spinal cord (at single or double level from T1 to L1). The patients with ossification of posterior longitudinal ligament (OPLL), ossification of ligamentum flavum (OLF), trauma, history of prior spine surgery, scoliosis, and infection were excluded from this study. Preoperative and postoperative evaluations for neurological status and clinical symptoms were performed in all patients. Patients were assessed for myelopathy using American Spinal Injury Association (ASIA) Impairment Scale, and Visual Analogue Scale (VAS) was used for evaluating thoracic radiculopathy or back pain. The presence of bowel and/or bladder symptoms was also examined. The clinical characteristics of HTD based on size, location, and presence of disc calcification; the factors related with applying additional instrumentation with fusion including sex, age, thoracolumbar region (defined as the segments between T9 and L1 vertebrae), multiple lesions, kind (unilateral / bilateral) and amount (partial / wide or total) of facet resection; and the surgical complications were analyzed retrospectively. Most of symptomatic herniated discs were excised through posterior approaches except four cases of only decompression without discectomy.

Preoperative MR imaging and computed tomographic (CT) scan were performed in all patients to document location, size (Giant HTD was defined as occupying more than 40% of spinal canal based on preoperative MR imaging *(7)*), and calcification of herniated disc. Postoperative MR imaging or CT scan was not done routinely, but used in the cases with sustained preoperative symptoms, additional instrumentation with fusion, or newly developed unexpected symptoms postoperatively.

Chi-square and Fisher's exact tests for relationships between categorical variables, and paired t-test for before and after observations in continuous variables were used for detecting statistical differences. Statistical analysis was carried out using SPSS version 20.0 software (SPSS Inc., Chicago, Illinois), and probability values of < 0.05 were considered statistically significant.

RESULTS

Thirty-eight patients were monitored for 33.29 ± 17.08 months (range, 16.5-83 months). The clinical symptoms were comprised of myelopathy (32 patients, 84.2%), radiculopathy (9 patients, 23.6%), and bladder or bowel symptoms (7 patients, 18.4%) (Fig. 1a). There were a total 45 HTDs in 38 patients, and 7 multiple HTDs (1 of T5/6/7, 2 of T6/7/8, 1 of T8/9/10, 2 of T10/11/12, and 1 of T9/10 combined with T11/12) were noted. The thoracolumbar region was the most common site for development of HTD (34 out of 45 HTDs, 75.6%) (Fig. 1b).

The HTDs predominated on the posterolateral portion (28/65, 62.2%) of the spinal canal, and there were 44.4% (20/45) of calcified and 31.1% (14/45) of giant-sized HTDs. The HTDs that had developed on the posterolateral portion showed a tendency toward a lower incidence of calcified and giant-sized discs, even though there was not a statistical significance ($p = 0.072$) (Table I).

All patients were treated via posterior approaches, which including 15 of unilateral facetectomy, 21 of bilateral facetectomy, 6 of transfacet-transpedicle, 2 of transdural, 1 of lateral extracavitary approaches with tailored laminectomy for 45 HTDs. Various posterior approaches were performed depending on the clinical features including size, location, and calcification of HTD (Table II and Fig. 2). Lateral extracavitary and transfacet-transpedicle approaches

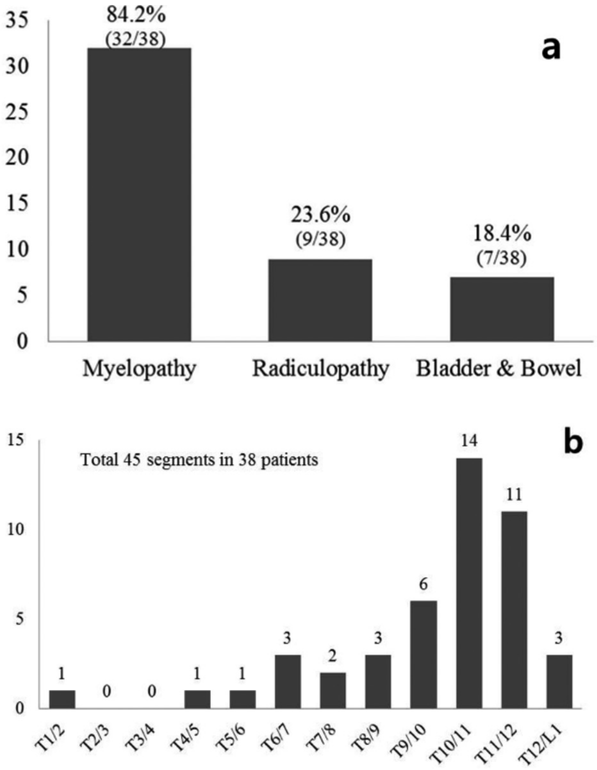

Fig. 1. — The characteristics of presented symptoms (a) and the distribution of symptomatic herniated thoracic discs (b).

Table I. — The clinical characteristics of herniated thoracic discs

		Size of disc	
		Giant (14/45, 31.1%)	No giant (31/45, 68.9%)
Location of disc	Central (17/45, 37.8%)	8 [4]	9 [2]
	Posterolateral (28/45, 62.2%)	6 [5]	22 [9]

[calcification: 20/45, 44.4%]

with unilateral total facetectomy, and transdural approaches with bilateral partial facetectomy were performed. In the HTDs with the clinical features of posterolateral location, no giant disc, and no calcification usually treated via unilateral facetectomy approach. On the other hand, there was a tendency that transfacet-transpedicle, lateral extracavitary, and bilateral facetectomy approaches were used in centrally located disc. Additionally,

Table II. — Various posterior approaches depend on clinical features of herniated thoracic discs.

	Location of disc			
	Central		Posterolateral	
	Size of disc		Size of disc	
	Giant	No giant	Giant	No giant
Unilateral facetectomy (15)	1 [0]	0 [0]	3 [3]	11 [3]
Bilateral facetectomy (21)	4 [3]	7 [2]	3 [2]	7 [4]
Transfacet-transpedicle (6)	1 [1]	1 [0]	0 [0]	4 [2]
Lateral extra-cavitary (1)	1 [0]	0 [0]	0 [0]	0 [0]
Transdural (2)	1 [0]	1 [0]	0 [0]	0 [0]

[calcification: 20/45, 44.4%], All of posterior approaches were performed with tailored laminectomy depending on the clinical features of herniated thoracic discs.

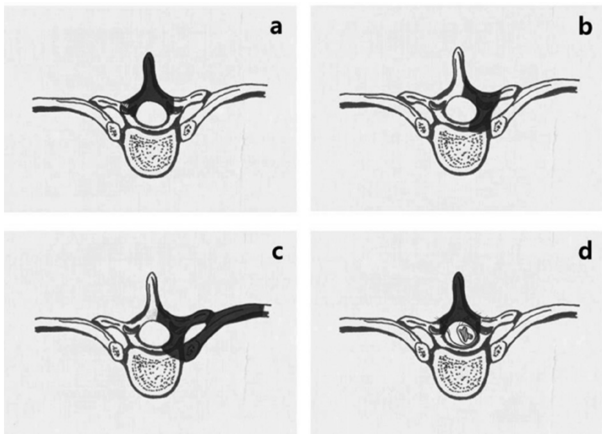

Fig. 2. — The illustration of posterior approaches under facetectomy (a), transfacet-transpedicle (b), lateral extracavitary (c), and transdural (d) methods, which were used in this study. Facetectomy was done with partial, wide, or total resection of facet joint unilaterally or bilaterally. Trandural approach was performed under bilateral partial facetectomy.

there were five patients underwent only posterior decompression with bilateral facetectomy for 8 HTDs, without resection of a herniated disc.

The additional instrumentation with fusion was performed in 14 patients (36.8%, 12 patients with single HTD and 2 patients with multiple HTDs) (Fig. 3a and b). The larger amount of facet joint resection (more than 50%, wide or total resection) was the only statistical significant factor for applying additional

Table III. — The factors associated with application of additional instrumentation with fusion.

Clinical factors		Instrumentation with fusion	
		(+) (14/38, 36.8%)	(-) (24/38, 63.2%)
Sex (M/F)	p=0.510	7/7	15/9
Age (years old)	p=0.893	61.21±12.71	60.03±13.08
T-L region (n)	p=0.216	13	17
Multiple lesion (n)	p=0.694	2	5
Kind of facet resection (Unilateral / Bilateral)	p=0.671	8/6	12/12
*Amount of facet resection (Partial / Wide or total)	p=0.023	4/10	16/8

T-L: thoracolumbar; Wide facet resection: more than 50%; * p<0.05

instrumentation with fusion (p = 0.023) (Table III). Although thoracolumbar region showed a tendency of additional instrumentation with fusion, there was no statistical relationship. There was no revision surgery for instability in the patients who did not undergo additional instrumentation with fusion at the initial operation.

Neurologically, all patients improved after surgery. The improvements of myelopathy and pain between preoperative and postoperative status were identified (Table IV). Preoperative ASIA grades exhibited were 1 in B, 6 in C, 26 in D, and 5 in E. At the final postoperative follow-up, no aggravations of ASIA grades were observed, as there were postoperative ASIA grades of 1 in C, 16 in D, and 21 in E. In the VAS score of thoracic radiculopathy

Table IV. — Pre- and postoperative ASIA scales and VAS scores

	Preoperative	Postoperative
ASIA scales		
A	0	0
B	1	0
C	6	1
D	26	16
E	5	21
VAS scores	5.45±1.50	3.05±1.61

ASIA scales: American spinal injury association impairment scales; VAS scores: Visual analogue scale scores

and back pain, there was a prominent decrease from 5.45 ± 1.50 to 3.05 ± 1.61 between pre- and post-operative statuses.

There were four complicated cases (4/38, 10.5%). The first case exhibited newly developed left leg

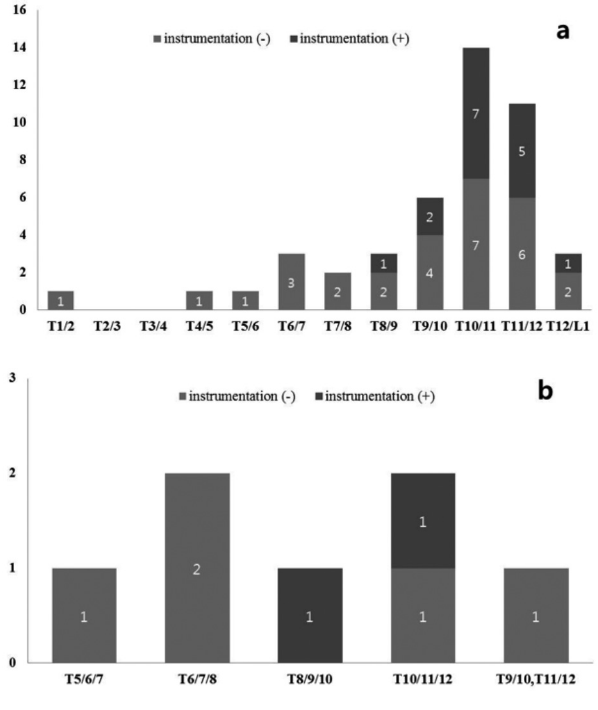

Fig. 3. — The incidence of additional instrumentation with fusion depends on single (a) or multiple herniated thoracic discs (b).

weakness after operation for centrally located and calcified giant disc herniation on T11/12, which was treated through the unilateral transfacet-transpedicle approach with pedicle resection. Fortunately, the neurological deficit was improved to nearly normal status with rehabilitation in the further follow-up. The second case was a recurred HTD on T12/L1 at three months postoperatively causing myelopathy as same as a preoperative symptom. After the revision surgery, the symptom was relieved. The third case showed aggravated back pain following a transfacet-transpedicle approach with sparing pedicle for the herniated disc at T7/8, postoperative MRI scan revealed spondylodiscitis at the operation site. Antibiotics therapy for 6 weeks was required for relieving back pain and reaching a normal range in a laboratory result (ESR/CRP). In the fourth case, there was no sufficient symptom relief for gait disturbance and leg weakness after surgery, the patient underwent only posterior decompression on T11/12 under total laminectomy without removal of the herniated disc. Follow-up MRI revealed an incomplete decompression and sustained cord compression by the herniated disc. This patient refused reoperation, and did not make a follow-up.

DISCUSSION

We could obtain a satisfactory long-term clinical result after total en bloc pisiform excision for intractable FCU tendinopathy. Post-operative pain relief and functional recovery was successfully achieved and satisfaction for surgery was high without recurrence of pain during the long-term follow-up. Pisiform is a small sesamoid bone underneath the distal insertion site of the FCU tendon. Although the symptom of this enthesopathy usually responds well to local steroid injection, when repeated injections fail, there is no other proven surgical option reported in the homogeneous patient group. In our experience, pisiform excision is a promising procedure to ensure long-term pain relief without functional deterioration.

We do not know the exact underlying mechanism through which the pain subsided after pisiform excision. One possible explanation is that the pisiform acts as an offending force towards the FCU tendon inducing micro-injury. The pain elicited by FCU tendinopathy resembles epicondylitis of the elbow, in which the cause is chronic repetitive micro-injury. When the degree of repetitive injury exceeds the natural healing capacity, a chronic disorganized lesion characterized by angiofibroblastic hyperplasia and further calcific material deposition could be observed at the tendon insertion site. Our assumption is that with excision of the pisiform, excessive strain over the FCU tendon produced by the mass effect of the pisiform would be reduced, and then sufficient time could be available for the enthesopathy to heal without further micro-injury. Furthermore, concomitant removal of some nerve endings over the pisiform, which are responsible for pain, might have a certain role in obtaining pain relief. Tendinosis (degenerative change) or tendinitis (mainly inflammatory change) as the cause of this condition might be another point of debate *(2)*. The most appropriate explanation for this entity might be enthesopathy, when we think of the fact that the symptom is relieved by removal of the insertion site (pisiform). Enthesopathy in an excised pisiform was once shown on histologic examination in another study *(8)*. However, clear distinction among these conditions is not very meaningful from the clinical aspect. Even tendinosis, in which there are no inflammatory cells in the degenerative tissue, usually shows a good short-term response to steroid injection.

Pisiform excision was usually indicated in OA or chondromalacia of the piso-triquetral joint and many authors have reported a successful clinical outcome *(3-5,7-9,11)*. In one large case series, pisiform excision was performed in 67 patients *(4)*. The patients usually consisted of those with post-traumatic piso-triquetral OA (30% of patients) or chondromalacia (40% of patients). They additionally treated 8 patients with FCU tendinitis and reported a good clinical outcome in most patients. In another large case series published in 1982, 21 patients underwent excision of the pisiform *(9)*. Six cases were caused due to OA and fracture was the reason for surgery in 5 patients. The remaining 10 patients were operated upon because of intractable FCU tendonitis. In this very heterogeneous group, the author reported that pisiform excision provided a satisfactory result in most patients. One article reviewed all the previous reports including a total of 216 cases in 1987 and concluded that 55.4% of patients who underwent pisiform excision had accompanying osteoarthritic change including primary, secondary (post-traumatic or post-operative) or inflammatory cause of OA *(8)*. The patient with FCU tendinitis (44.6%) was the second most common entity in the pooled data.

There is still little consensus on the adequate surgical option for intractable FCU tendinopathy. Besides excision of the pisiform, simple debridement of the degenerative portion of the FCU tendon was also introduced *(2)*. The authors defined the pathology in their patiens as tendinopathy, because patients usually had tenderness not over the pisiform, but over the more proximal area (3 cm proximal) from the pisiform. Histologic examination also showed typical tendinopathy. They debrided the distal portion of the tendon after making a longitudinal incision over the tendon. Degenerative portion, which is usually located in the deep surface, was removed with a scalpel until healthy tissue was encountered. Although they reported a good clinical outcome, one limitation was the small number of patients (a total of 4 patients). The nature of pathology did not seem to be similar to that in our patients because the location of the tender point was different. We agree that if the degenerative portion of the tendon is removed adequately, the symptom would be alleviated. However, in some cases, the degenerative change is very unclear on gross examination, causing difficulty in delineating the extent of debridement, resulting in incomplete debridement. Furthermore, if the pisiform acts as an offending factor that induces tendinopathy, symptom could recur later. Because of these concerns, we prefer excision of the pisiform for this disease entity. The limitation of the above mentioned article was that all patients filed a worker's claim and three patients had an associated condition besides FCU tendinopathy such as wrist synovitis, carpal tunnel syndrome, or De Quervain syndrome requiring surgical management, which complicated the analysis of post-operative data.

Many studies have showed that wrist weakness and joint instability do not occur after total excision of the pisiform if the integrity of the surrounding soft tissue is meticulously preserved *(1,6,9)*. It is known than the FCU function was not impaired after pisiform excision and it had little effect on flexion strength of the wrist *(10)*. Wrist flexion power was equal to or less than that on the contra-lateral non-affected side *(1)*. But the difference was not statistically significant. No late dysfunction of the FCU or wrist was noted clinically *(4)*.

Our article has several limitations. Firstly, this is a retrospective case series without a comparative group. Further prospective comparative study is required. Secondly, small number of patients was another limitation. Because many patients were successfully treated conservatively, it was difficult to gather a large number of patients who had intractable FCU tendinopathy as the sole reason for surgery. The final limitation was that we did not measure the objective outcome such as range of wrist motion, grip power, or flexion strength of the wrist before and after surgery. However, we can expect that the objective outcome would be maintained after surgery according to the previous report.

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