



## Surgery for Giant Calcified Herniated Thoracic Discs: A Systematic Review

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### Key words

- Calcified
- Complications
- Giant
- High-risk herniated thoracic disc
- Outcome
- Surgical approach
- Thoracic disc herniation

### Abbreviations and Acronyms

- AP:** Anteroposterior  
**CSF:** Cerebrospinal fluid  
**HTD:** Herniated thoracic disc  
**MEP:** Motor-evoked potential

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Herniated thoracic discs (HTDs) usually are demonstrated on magnetic resonance imaging, which detects HTDs in up to 37% of asymptomatic individuals.<sup>1</sup> HTDs often present with axial pain and/or pain irradiating to the lateral and anterior thorax or abdomen uni- or bilaterally followed by progressive myelopathy, such as sensory disturbance, weakness, bowel and bladder dysfunction, and paralysis. Furthermore, some HTDs also cause acute myelopathy.<sup>2</sup> HTDs are more likely to injure the spinal cord compared with their cervical and lumbar counterparts because the thoracic spinal cord is in an obligate anterior position in the spinal canal (close to the posterior longitudinal ligament and intervertebral discs) as it follows the kyphotic curvature of the thoracic spine.<sup>3</sup> Moreover, it has smaller canal and tenuous blood supply to the cord compared with the rest of the spine.<sup>4,5</sup> However, the exact pathophysiology of symptomatic HTDs (as

■ **OBJECTIVE:** The giant calcified herniated thoracic disc (HTD), a rare disease, is a challenge for surgeons because of its complications. This review aimed to confirm the surgical treatment, including surgical approach, results, and complications of HTDs.

■ **METHODS:** This systematic review of the literature complies with the PRISMA guidelines and involves a search of PubMed, Embase, and the Cochrane Library for all papers describing surgical treatment of giant calcified HTDs in  $\geq 3$  patients. Data on the surgical approach, change in neurologic impairment, and complications were extracted from the search results.

■ **RESULTS:** A total of 11 studies, including 164 patients with giant calcified HTDs that met the inclusion criteria, were included in this systematic review. Of the 164 patients, 145 had myelopathy in giant calcified HTDs, and 8 surgical approaches were included. After the surgical treatment, the neurologic grades were improved in 69% of patients, remained unchanged in 22% of patients, and worsened further in 3% of patients at the final follow-up. Also, of the total patients analyzed, 3% had permanent neurologic deterioration, 4% patients had subarachnoid–pleural cerebrospinal fluid fistula complications, 30% had other complications, 4% had reoperation via transthoracic approach, 13% had permanent neurologic deterioration via the posterolateral approach, and 25% had permanent neurologic deterioration via the thoracoscopy approach.

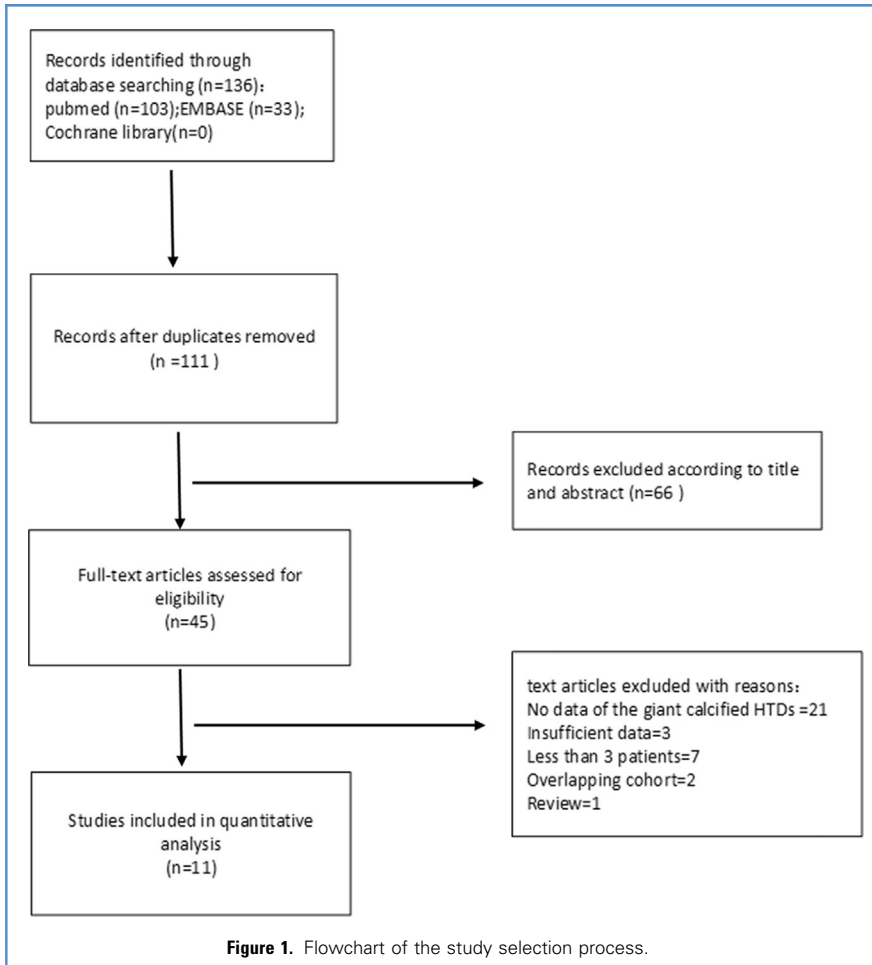
■ **CONCLUSIONS:** Surgical treatment can improve or stabilize neurologic impairment for most patients with giant calcified HTDs. We thus recommend the anterior thoracotomy approach for giant calcified HTDs because of the theoretical advantages over other approaches and the low rate of neurologic deterioration, subarachnoid–pleural cerebrospinal fluid fistula, and reoperation.

many of them appear to be asymptomatic for prolonged periods or even throughout life) remains unknown.<sup>3,6</sup> Symptomatic HTDs usually require surgical intervention.

In 2005, Hott et al.<sup>7</sup> were the first to define giant HTDs, i.e., occupying at least 40% of the anteroposterior (AP) diameter of the spinal canal based on examination of computed tomography myelography, magnetic resonance imaging, or both. Giant HTDs cause myelopathy more frequently and show worse functional outcomes as compared with small HTDs. Giant HTDs have 3 subtypes: dense calcification, partial calcification, and soft (often developing into calcification).<sup>8</sup> Giant calcified HTDs account for 76%–95% of all giant HTDs and belong to the subgroup of high-risk

HTDs, as recently defined by Cornips et al.<sup>2</sup> Giant calcified HTDs manifest a unique presentation, pathology, and treatment.<sup>7-9</sup> Therefore, their treatment remains challenging for surgeons worldwide.

Most surgeons recommend surgery for giant HTDs and giant calcified HTDs because those HTDs frequently lead to the development of myelopathy. The surgical approaches for giant calcified HTDs involve the anterior approach (e.g., thoracotomy, mini-thoracotomy, and thoracoscopy) and posterolateral approach (e.g., costotransversectomy and transpedicular approaches).<sup>9</sup> Major surgical complications of giant calcified HTDs include subarachnoid–pleural cerebrospinal fluid (CSF) fistula and neurologic



impairment because they may adhere to and/or intrude into the dural (called the intradural disc), leading to difficulty in surgical separation.

However, there is a scarcity of high-quality studies on giant calcified HTDs (rare diseases), which makes it difficult to establish an evidence-based treatment algorithm. More knowledge about the results of surgical treatment and complications of all types of surgical approaches would help patients better understand giant calcified HTDs and facilitate in decision-making for surgeons based on the available evidence. Therefore, a review of all papers associated with giant calcified HTDs published to date was undertaken to answer the following questions: 1) the types of surgical approaches applied to giant calcified HTDs, 2) the result of neurologic impairment after operation, and 3)

the complications related to surgical approaches for giant calcified HTDs.

## MATERIALS AND METHODS

This investigation was performed at the Department of Orthopaedic Surgery, West China Hospital, Sichuan University, Chengdu, China.

### Search Strategy

We conducted a systematic review in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.<sup>10</sup> The databases searched included PubMed, Embase, and Cochrane library from the inception of the databases to January 2018. We used the following key words or Medical Subject Headings items for the search: “herniated thoracic discs,” “thoracic disc herniation,” “calcified,” “calcification,”

“giant,” and “huge.” The filters of the search were limited to the English language and trials in humans only. We also manually searched for relevant articles by checking reference lists of retrieved studies or reviews. Only those studies published with a full text available were included. When several publications reported findings for the same patients, the most recent or most complete study was selected.

### Inclusion and Exclusion Criteria

We selected studies that complied with the following criteria: 1) patients with symptomatic giant calcified HTDs (occupying at least 40% of the AP diameter of the spinal canal); 2) the treatment was operation; 3) patients included were no younger than 3 years of age; 4) average follow-up period of  $\geq 6$  months; and 5) at least one of the following outcomes was present: surgical approach, result of neurologic impairment including pre-operation and postoperation, and surgical complications. The exclusion criteria for the studies included 1) letters, comments, abstracts for conferences, study protocols, and reviews; 2) repeated study; and 3) the presence of other serious combined diseases such as thoracic tumors, fractures, and tuberculosis.

### Data Extraction

Two authors (M.G. and G.L.) independently reviewed all titles, abstracts, and the full text to identify eligible articles. Data were obtained, including the name of the first author, year of publication, study design, country of study, patient characteristics (mean age, rate of female patients), symptoms, surgical approach, level of HTDs, site of disc, transdural disc, neurologic impairment, period of follow-up, intraoperative neurologic monitoring, grades of neurologic impairment before and after operation, and complications. In case of disagreements between the 2 authors, a third author (Z.X.) was consulted to reach a final decision.

## RESULTS

A total of 136 studies were initially retrieved through the database search. After eliminating duplicate papers, 111 studies were obtained for further screening. Then, 67 studies were removed

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