



Anterior versus posterior approaches for thoracic disc herniation: Association with postoperative complications



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ABSTRACT

Objective: Thoracic disc herniations (TDH) represent 1.5–4% of all intervertebral disc herniations. Surgical treatment can be divided into anterior, lateral and posterior approaches and is an area of contention in the literature. Available evidence consists mostly of single-arm, single-institutional studies with limited sample sizes. The objective of this study is to investigate 30-day surgical outcomes following excision of TDH utilizing a national surgical registry.

Patients and Methods: The American College of Surgeons - National Surgical Quality Improvement Program (ACS-NSQIP) was queried for cases that underwent anterior (thoracotomy or thoracoscopy), lateral (extracavitary or costotransversectomy) or posterior (transpedicular or laminectomy) surgery for a primary diagnosis of TDH between 2012 and 2015.

Results: A total of 388 patients (48% females) were included in the analysis. An anterior approach was used in 65 patients, lateral approach in 34, transpedicular approach in 90 and laminectomy in 199. Overall, baseline demographics and clinical characteristics were similarly distributed between the four procedure groups. Patients undergoing an anterior approach spent, on average, 2–3 more days in the hospital compared to the other groups ($p < .001$). Furthermore, they were more likely to have developed a major complication (27%) compared to the lateral (8%), transpedicular (18%) or laminectomy group (14%) ($p = .13$). Unplanned 30-day readmission and return to the operating room occurred in 5–8% of patients ($p = .69$ and 0.63 , respectively). Lastly, the majority of the patients were discharged to home or a home facility (anterior-74%; lateral-81%; transpedicular-68% and laminectomy-74%, $p = .58$).

Conclusion: Anterior approaches had longer LOS and higher, although not statistically significant, complication rates. No difference was found with regard to discharge disposition. In light of these findings, surgeons should weigh the risks and benefits of each surgical technique during tailoring of decision making.

1. Introduction

Thoracic disc herniations (TDH) constitute 0.15–4% of all disc herniations, with an estimated occurrence in the general population ranging from 0.1% and 0.0001% [1,2]. TDH occur most commonly in males between the age of 40–60 years and may present with signs and symptoms of myelopathy, radiculopathy or both [3,4]. Given the potential for spinal cord compression and irreversible neurologic damage,

surgical intervention is considered the treatment of choice.

There is a significant amount of controversy surrounding the superiority in surgical approaches with evidence suggesting that both anterior and posterior approaches show similar neurological improvement [1,3]. Historically, laminectomy was the treatment of choice but was later abandoned due to the association of a 33% postoperative morbidity and 13% mortality rate [5]. Within the last 20 years, novel and less invasive techniques have emerged with acceptable functional

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outcomes results and low complication rates. These new techniques include the transpedicular, extracavitary, costotransversectomy approach as well as anterior techniques, such as thoracotomy and thoracoscopy.

Several previous studies have attempted to investigate the complication and functional outcomes profile following thoracic disc excisions [2,5–8]. However, these studies present several limitations, namely the lack of a comparison group, small sample size and single-institutional nature. To address this gap in the literature, 30-day surgical outcomes associated with anterior, lateral and posterior thoracic disc excisions in a multi-institutional surgical registry were investigated.

2. Materials and methods

2.1. Data source

The American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) Participant Use File for the years 2012 through 2015 was utilized for the current retrospective cohort study. The NSQIP database consists of over 320 variables including patient demographics, comorbidities, intraoperative variables and 30-day postoperative complications [9]. The registry was launched in 1994 and has steadily grown each year [10]. It currently contains information on over 1.7 million patients from more than 500 hospitals with 58% considered to be large academic institutions [11]. The data represent a random sample of all procedures performed by different surgical subspecialties at each institution [12]. Specialized data collectors that undergo extensive training are responsible for carrying out data abstraction at participating institutions every 8 days. According to the most recent report, the overall disagreement rate based on an inter-rater reliability audit for participating sites is approximately 2% [13]. This study contained de-identified data, therefore it was exempt from approval by our Institutional Review Board.

2.2. Inclusion and exclusion criteria

Cases with TDH were identified using the International Classification of Diseases, 9th (ICD-9) and 10th (ICD-10) edition diagnosis codes indicating displacement of intervertebral disk with (722.72, M51.04, M51.05) or without myelopathy (722.11, M51.24, M51.25). Afterwards, patients were classified into the following procedure groups using the corresponding Current Procedural Terminology (CPT) codes: anterior approach, extracavitary approach, costotransversectomy, transpedicular approach and laminectomy (with or without facetectomy) (Table 1). Due to relatively low number of extracavitary and costotransversectomy procedures, these were combined into lateral approaches. We also recorded the addition of arthrodesis. Patients were excluded if they met one of the following criteria: prior operation within 30 days, chemotherapy within 30 days, radiotherapy within 90 days, age below 18 and above 90, primary designated surgeon other than neurosurgeon or orthopedic surgeon, sepsis/septic shock on admission and history of disseminated cancer.

Table 1
Summary of Current Procedural Terminology Codes used.

Procedure	Code
Laminectomy	63003, 63016, 63046, 63048, 63050, 63051, 63266
Costo-transversectomy	63064, 63066
Transpedicular approach	63055, 63057
Extracavitary approach	63101, 63103
Anterior approach	63077, 63078, 63085, 63086

2.3. Outcomes of interest

The primary outcome of interest was the development of a major complication within 30 days. Major complications included the following: wound dehiscence, deep surgical site infection (SSI), organ space infection, pneumonia, reintubation, pulmonary embolism, failure to wean ventilatory support within 48 h of surgery, renal failure or insufficiency, stroke, cardiac arrest, myocardial infarction and sepsis/septic shock [9]. Secondary outcomes consisted of unplanned readmission and return to the operating room within 30 days after surgery as well as development of a minor complication, i.e. deep vein thrombosis (DVT), urinary tract infection (UTI) or superficial SSI. Last, we investigated length of stay (LOS) as well as adverse discharge disposition which was defined as discharge to a location other than home (skilled care, rehabilitation facility or unskilled care) for patients that were admitted from home. We also examined the occurrence of prolonged LOS, which was defined as LOS greater than the 75th percentile.

2.4. Covariates

The covariates of interest included: age, race, gender, Body Mass Index (BMI), operative time (in minutes), functional status, physical status classification as described by the American Society of Anesthesiologists [14] (ASA), history of diabetes, smoking status, presence of myelopathy and history of chronic corticosteroid use within 30 days of the index operation [15]. Coexisting conditions were grouped into the following composite comorbidities, as previously described [16]: cardiovascular, neurological, respiratory, renal, hepatobiliary and hematological (Supplemental Table S1).

2.5. Statistical analysis

Descriptive statistics (medians with interquartile ranges for continuous data and frequencies with proportions for categorical data) were used to present available information. Wilcoxon Rank Sum and Pearson's Chi-square test were used to compare continuous and categorical variables respectively. ASA classification was collapsed into two categories, i.e. low (class I and II) and high (class III and IV). Multivariable logistic regression models were fitted for major complication, prolonged length of hospital stay and adverse discharge disposition after adjusting for age, sex, BMI, race, fusion, myelopathy, smoking status, ASA class and diabetes, in order to investigate the independent effect of procedure type. Age and BMI, as continuous variables, were modeled using restricted cubic splines with 3 knots, which allow for more flexible relationship with the binary outcomes of interest. Collinearity between the included covariates was examined using the variance inflation factor. Model discrimination was assessed using the c-statistic. Statistical analysis was performed using an open-source software (R Core Team (2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>) and the "rms" package [17]. P-values were statistically significant if less than .05.

3. Results

3.1. Patient demographics and comorbidities

We identified 634 patients in NSQIP registry who underwent spinal surgery for TDH between 2012 and 2015. After applying exclusion criteria, our final cohort consisted of 388 unique cases. Laminectomy was performed in 199 patients, a transpedicular approach was used in 90, a lateral approach in 34, while an anterior disc excision was carried out in 65 patients.

A summary of baseline demographic information and comorbidities is presented in Table 2. Median age was significantly higher for patients undergoing a posterior approach (laminectomy-57, transpedicular-56)

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