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Clinical commentary

The incidence of adjacent segment disease after lumbar discectomy: A study of 751 patients

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ABSTRACT

Introduction: The objective of this study is to determine the incidence and prognostic factors of adjacent segment disease (ASD) following first-time lumbar discectomy (LD).
Methods: We retrospectively reviewed all neurosurgical patients who underwent first-time LD for degenerative lumbar disease from 1990 to 2012. ASD was defined as a clinical and radiographic progression of degenerative spinal disease that required surgical decompression (with or without fusion) at the level above or below the index discectomy. Adjusted odds ratios were calculated from multivariable logistical regression controlling for sex and age, as well as postoperative sensory deficit, motor deficit, back pain, neurogenic claudication, and radiculopathy.
Results: Of the 751 patients who underwent single-level LD, the cumulative reoperation rate for degenerative spinal disease was 10.79%. The incidence of ASD requiring reoperation was 4% over 3.11 years. More specifically, the incidence of adjacent level discectomy was 1.86% over 3.45 years. The annualized reoperation rate for ASD was 1.35% (1.35 ASD reoperations per 100 person-years). The 63.33% incidence of cranial ASD requiring reoperation was statistically significantly higher than the 40.00% incidence of caudal ASD requiring reoperation. Following multivariable logistical regression, the strongest (and only) statistically significant predictor of ASD requiring reoperation was lower extremity radiculopathy after the index discectomy operation (OR = 14.23, $p < 0.001$).
Conclusions: In the first series on ASD following first-time LD without fusion, the rate of reoperation for ASD was 4% and the cumulative reoperation rate 10.79%. Rostral ASD is more common than caudal ASD and lower extremity radiculopathy is the strongest predictor of ASD.

1. Introduction

Lumbar discectomy is one of the most common procedures performed by spinal surgeons [1,2]. The outcomes of patients with first-time or recurrent herniated lumbar discs have been under intense investigation in the literature [3,4]. Several authors have recently noted that, following the initial operation, a second lumbar discectomy may be required at an adjacent segment in a limited number of patients [5,6]. Heretofore, the incidence of adjacent segment disease (ASD) following a lumbar discectomy has not been examined. In this manuscript, we present a study on ASD after first-time, single-level lumbar discectomy without fusion. We also determine the strongest predictors of ASD following the index operation.

2. Methods

We retrospectively reviewed the electronic medical records of all neurosurgical patients who underwent first-time, single-level lumbar discectomy for degenerative spinal disease from 1990 to 2012 at a single institution. Patients with laminoplasty, complete facetectomy, fusion (instrumented or in situ), or ⩾4 level laminectomy were excluded. Similarly, non-degenerative indications for

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Table 1
Perioperative demographics of 751 patients undergoing first-time, single-level lumbar discectomy for degenerative spinal disease.

	n = 751 (%)
Sex, male	418 (55.66)
Mean age	49.39 ± 15.66
CoMorbidities	
Chronic Obstructive Pulmonary Disease	12 (1.60)
Coronary Artery Disease	31 (4.13)
Depression	51 (6.79)
Diabetes Mellitus	65 (8.66)
Hypertension	163 (21.70)
Obesity	31 (4.13)
Osteoporosis	12 (1.60)
Smoking	95 (12.65)
IntraOperative parameters	
Median Blood Loss, Interquartile Range(cubic centimeters)	100, 100
Durotomy	39 (5.19)
PostOperative outcomes	
Mean Length of Hospital Stay	2.16 ± 2.15
PostOperative Cerebrospinal Fluid (CSF) Leak	12 (1.60)
Discharge to Rehab	27 (3.60)
Deep Vein Thrombosis	0
Hematoma	1 (0.13)
Hematoma Evacuation	1 (0.13)
Surgical Site Infection (SSI)	6 (0.80)
Wound Debridement	3 (0.40)
Dehiscence	5 (0.67)
Wound Closure	4 (0.53)
Adjacent Segment Disease	30 (4.00)

lumbar decompression, such as neoplastic, infectious, traumatic, congenital, and metabolic etiologies, were excluded.

A total of 751 patients met our selection criteria. Perioperative variables including preoperative demographics, comorbidities, intraoperative parameters, and postoperative outcomes were ascertained from patient records. The primary outcome of this clinical study was the incidence of adjacent segment disease after lumbar discectomy. ASD was defined as clinical and radiographic progression of degenerative spinal disease requiring reoperation (laminar decompression and/or discectomy with or without fusion) at the level above or below the index discectomy. More specifically, we also documented the incidence of adjacent level discectomy, which refers to ASD requiring a discectomy at the rostral or caudal level.

Patient demographics were described with summary statistics. Patients undergoing lumbar discectomy were compared in Table 1. Binary outcomes were compared using a chi-squared (χ^2) test. Continuous outcomes were compared with a t-test between two groups and an ANOVA among three or more groups. Time to ASD was analyzed with a Kaplan–Meier curve. Incident rates (IR) were expressed as a function of person-time (number of ASD cases per year). A binary logistical regression model was fitted to estimate the effect of independent predictors on the primary outcome, ASD. The results of simple and multiple logistical regressions are reported with odds ratios. When the outcome was small, an exact logistical regression was utilized. Statistical significance was set at $p \leqslant 0.05$.

3. Results

In our institutional series, 751 patients underwent first-time, single-level, lumbar discectomy. The mean age was 49.39 years, and 55.66% were males (Table 1). In addition to the discectomy, 26.30% underwent a one-level laminar decompression, 61.10% underwent a two-level laminar decompression, and 12.60% underwent a three-level laminar decompression. The distribution of the first-time, single-level lumbar discectomy cases was 0.40% ($n = 3$) at L1-L2, 5.06% ($n = 38$) at L2-L3, 11.32% ($n = 85$) at L3-L4, 40.88% ($n = 307$) at L4-L5, and 42.34% ($n = 318$) at L5-S1 (Fig. 1).

Of the 751 patients, the cumulative reoperation rate was 10.79% ($n = 81$). Fifty of these cases (6.66%) included a discectomy. The incidence of ASD requiring reoperation was 4% ($n = 30$); more specifically, the incidence of adjacent level discectomy (ASD requiring a discectomy at the rostral or caudal level) was 1.86% ($n = 14$). Of the 30 patients who underwent reoperation for ASD, the distribution of cases was 0% at L1-L2, 10.00% ($n = 3$) at L2-L3, 26.67% ($n = 8$) at L3-L4, 40.00% ($n = 12$) at L4-L5, and 26.67% ($n = 8$) at L5-S1 (Fig. 1). One patient developed ASD both cranially at L3-L4 and caudally at L5-S1. Cumulatively, the 63.33% incidence of cranial ASD requiring reoperation (n = 19) was statistically significantly higher than the 40.00% incidence of caudal ASD requiring reopeation ($n = 12$) ($p < 0.001$) (Fig. 2). Of the 30 reoperations for ASD, forty percent ($n = 12$) of patients underwent decompression alone versus sixty percent ($n = 18$) of patients who required fusion. In the arthrodesis cohort, 36.66% of patients ($n = 11$) required an instrumented posterolateral lumbar fusion without interbody, and 23.33% ($n = 7$) of patients required an interbody fusion (all of which were posterior or transforaminal lumbar interbody fusions).

Following a multiple logistical regression, the strongest (and only) statistically significant predictor of ASD requiring reoperation was lower extremity radiculopathy after the index discectomy operation (OR = 14.23, $p < 0.001$) (Fig. 3). Of the 30 ASD cases, lower extremity radiculopathy was the clinical indication for reoperation in 70% ($n = 21$) of patients. On the other hand, reoperation for ASD was not predicted by sensory deficits ($p = 0.202$), motor deficit (p-value approached 1.00), back pain ($p = 0.103$), neurogenic claudication ($p = 0.09$), and sex ($p = 0.721$). The marginal affect of age was likely due to a survival bias (OR = 0.97, $p = 0.049$).

Time to reoperation for ASD occurred over a mean of 3.11 years (Fig. 4). The annualized reoperation rate was 1.35% [IR = 1.35 ASD reoperations per 100 person-years]. Similarly, the time to reoperation for adjacent level discectomy (ASD requiring a discectomy at the rostral or caudal level) was 3.45 years.

4. Discussion

Although recurrent disc herniation at the index level of the operation has been thoroughly studied in the literature, progression of degenerative disease to the adjacent levels after discectomy has not been well-established. In 1994, Davis et al. followed 984 patients who underwent lumbar discectomy (99.19% of all cases were one-level operations) over a mean of 10.8 years [5]. While the incidence of adjacent level discectomy was not explicitly defined, the authors noted that reoperation for "disc herniation at a different level" occurred in 20 patients (2.03%). In a 10-year follow up study published in 2001, Yorimitsu et al. retrospectively reviewed 72 patients who underwent lumbar discectomy [6]. Only one patient (1.39%) required a discectomy at the adjacent level. In our institutional series, we report a similar incidence of 1.86% for adjacent level discectomy over a mean of 3.68 years. The annualized reoperation rate for adjacent level discectomy was 0.61% [IR = 0.61 adjacent level discectomy per 100 person-years].

In a review article published in 2004, Hilibrand et al. defined ASD as clinically-symptomatic degeneration at the level adjacent to the index operation [7]. As such, reoperations for ASD may include a laminar decompression with or without discectomy. In this study, we found that the incidence of reoperation for ASD was 4% over a mean of 3.11 years. Similar studies have confirmed our results. Lewis et al. prospectively followed 83 patients for 5–10 years after first-time, single-level lumbosacral discectomy [8]. The rate of repeat laminectomy and/or discectomy at the adjacent