

## Determining the Extent of Lumbar Discectomy in Patients with Herniated Lumbar Discs

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Lumbar discectomy for lumbar disc herniation is one of the most common spine procedures performed. The incidence of symptomatic herniated lumbar discs is estimated to be between 1-2% [1] and over 480,000 lumbar discectomies are performed annually in the United States [2, 3]. Lumbar discectomies are effective in relieving back and leg pain [4] and patient outcomes and satisfaction after discectomy have been reported in 75-80% of patients receiving surgery [5-7]. However, a common complication after lumbar discectomy is recurrence of herniated disc which has been reported to occur in the range of 3-18% [8, 9]. Recurrent lumbar disc herniation is usually treated with open technique with wider exposure for discectomy, or in cases of significant instability and/or loss of disc height, lumbar interbody fusion [10]. This complication results in increased patient hospitalization and cost as well as missed work days. All of these contribute to an increased economic burden on the United States health care system [8, 9]. It has been estimated that reoperation for recurrent herniated discs in the lumbar spine resulted in a normalized cost of \$298,797 per 100 primary discectomies in the setting of a recurrence rate of 12% [11].

Much research has been done to determine how to effectively reduce the rate of recurrence of lumbar disc herniation after surgical treatment. One area of debate is how aggressive should the surgeon be when performing discectomy for lumbar disc herniation. There have been many studies comparing the less-aggressive sequestrectomy versus the subtotal standard discectomy.

Sequestrectomy is performed by simply removing the free fragment of herniated disc material posterior to the vertebral body that is compressing the neural elements. There is no probing into the annulus or nucleus pulposus to remove additional disc material. The rationale behind not going into the disc space is to minimize postoperative pain and to maintain stability at the operated disc level [12, 13]. In fact, Carragee et al found significantly better visual analog scale and Oswestry scores at 6- and 12-month follow-up in the limited discectomy group, despite a higher reherniation rate, relative to standard discectomy [8].

On the other hand, in a subtotal standard discectomy, the surgeon removes not only the free fragment of herniated disc material but also opens the annulus and removes additional disc material from the disc space along with possible endplate curettage. The rationale behind performing a more aggressive disc removal

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with endplate curettage is that the reherniation rate is reduced relative to a less aggressive disc removal [8].

In regards to reherniation rates, multiple studies have corroborated that subtotal standard discectomy has lower reherniation rates compared to sequestrectomy. Shamji et al conducted a retrospective study of 198 patients over a 10-year period of time comparing two cohorts of patients at a single institution. One cohort of 98 patients was treated by Surgeon A, who performed sequestrectomy of the herniated disc material, and the other cohort of 74 patients was treated by Surgeon B, who performed subtotal standard discectomy. The study found that the subtotal standard discectomy group had lower reherniation rates (10%) versus the sequestrectomy group (19%). Furthermore, there was no significant difference in the length of surgery or in estimated blood loss in the two cohorts. A meta-analysis of twenty-five studies by McGirt et al concluded that although there was no level

I evidence to support aggressive versus conservative discectomy for the treatment of primary disc herniation, their systematic review of the literature suggested that conservative discectomy may result in shorter operative time, faster return to work, and a decreased incidence of long-term recurrent low back pain. However, the meta-analysis found that the rates of recurrent disc herniation were twice as high in the conservative sequestrectomy group compared to the more aggressive discectomy group [12]. Per the study by McGirt et al, the only Level II evidence in the literature was a prospective randomized study by Thome et al in 2005 that found that sequestrectomy does not entail a higher rate of early recurrences compared with standard discectomy. In this study, 84 consecutive patients 60 years of age or younger who harbored free, subligamentary, or transannular herniated lumbar discs refractory to conservative treatment were randomized to either the sequestrectomy or the standard microdiscectomy groups [14]. Reherniation rates were 10% after standard discectomy and 5% after sequestrectomy. Moreover, at 4- and 6-months, the Short Form-36 and Patient Satisfaction Index scores trended in favor of sequestrectomy leaving 3% of patients unsatisfied in comparison to 18% treated with standard discectomy. However, another prospective randomized trial of 78 total patients by Barthe et al [15] found that reherniation rates within 2 years after sequestrectomy and microdiscectomy were comparable [15]. Furthermore, a recent meta-analysis by Huang et al in 2015 concluded that based on current evidence, sequestrectomy significantly reduced the operational time, but had similar reherniation rates, length of hospital stay and postoperative VAS scores for leg and back pains compared to standard microdiscectomy. Thus, there is no clear consensus in the literature even though many of the studies have trended towards higher rates of recurrent disc herniation associated with sequestrectomy compared to standard discectomy.

Although standard discectomy may have lower reherniation rates compared to sequestrectomy, there are several drawbacks to performing a more aggressive disc removal. Standard discectomy is associated with increased loss of disc height over time compared to sequestrectomy (63% vs. 38%). Furthermore, accelerated degeneration reflected in increase of 30% or more in Modic type endplate changes at the operated level were observed at a significantly higher rate in the standard discectomy cohort versus the sequestrectomy cohort (47 vs. 14%) [16]. Of note, there was a significant correlation between Modic type endplate changes and low back pain. The study concluded that sequestrectomy had significantly less postoperative disc degeneration than standard discectomy after 2 years.

Several studies have explored other ways to limit disc reherniation. One such proposed solution is annular repair. In a prospective, multicenter, randomized, controlled study of annular repair with two-year follow-up, Bailey et al found that while not statistically significant, annular repair trended towards reducing the need for subsequent reherniation surgery while maintaining the clinical benefits of discectomy with no increased risk for patients [17]. However, there was found a significant reduction in reherniation at 3 and 6 months post-operatively for patients receiving annuloplasty in the subgroup of patients who presented predominantly with leg pain. In vitro experiments exploring tolerated pressures in the disc space have found that annular repair increased the strength of the disc in tolerating intradiscal pressures and retaining intradiscal material [18]. In a prospective study by Carragee et al, lumbar disc herniation type was categorized into 1) type I, fragment-fissure herniation; 2) type II, fragment-defect herniation; 3) type III, fragment-contained herniation; and 4) type IV, non-fragment-contained herniation. Recurrence rates were investigated among the different groups, and it was found that recurrent disc herniations were most common when an extruded free fragment was identified in the presence of a large annular defect (greater than 6 mm) [8]. This patient population may potentially be of particular benefit from annuloplasty, but further investigations are needed.

Lastly, it important to be cognizant of risk factors that may be associated with recurrent lumbar disc herniation. These risk factors include age, gender, smoking, increased body mass index, disc degeneration, trauma, occupational lifting, characteristics of the original disc herniation, and the aggressiveness of the discectomy [8, 19-23]. Kim et al found that increased disc height and increased segmental range of motion pre-operatively were associated with higher rates of recurrent disc herniation [22]. Patients with increased risk factors require more focused outpatient follow-up after surgery.

Understanding potential risk factors for lumbar disc reherniation will enable the surgeon to minimize the risks of recurrent disc herniation. Of the factors that are controlled by surgical technique, the trend in the literature is that subtotal standard discectomy is associated with decreased risk of recurrent disc herniation. However, sequestrectomy is associated with better clinical outcomes in regards to improved post-operative pain control and stability at the operated level. Despite multiple studies and systemic reviews, there is still much controversy over the superiority of sequestrectomy versus subtotal standard discectomy, and more research is needed to further improve outcomes after surgery for herniated lumbar discs.

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