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Evaluation of Minimal Invasive Fragmentectomy in Treatment of Lumbar Disc Prolapse

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Abstract

Background: Various surgical methods were described for treatment of lumbar disc prolapse including microdiscectomy, later sequestrectomy was described for preservation of disc height and minimalizing the surgical intervention.

Aim of Study: The aim of this study is to evaluate the outcomes of lumbar disc fragmentectomy in patients with lumbar disc herniation in terms of pain (back pain and radicular) relief, improvement of neurological deficit if present, hospital stay duration, time consumed for return to work, and the incidence of complications with this intervention compared to conventional microdiscectomy.

Patients and Methods: This is case series study, where patients having lumbar disc herniation were evaluated preoperatively both clinically and radiologically patients were operated by microfragmentectomy and followed-up conducted for 3 months for recurrence rate and outcomes.

Results: We operated twenty cases in this study, with microfragmentectomy, the mean age of patients was 34.75 years, there were 15 males and 5 females, postoperative pain improvement was better in microfragmentectomy. Hospital stay, blood loss, and postoperative complications were less in microfragmentectomy.

Conclusion: Microfragmentectomy allows good surgical visualization and is less traumatic to the involved tissues. The results of this study indicated that microfragmentectomy reduces hospitalization time, improves the overall surgery related outcome, microfragmentectomy allows patients earlier return to work and normal life with less reliance on postoperative narcotic analgesic agents.

Key Words: *Disc prolapse – Microfragmentectomy – Minimally invasive.*

Introduction

DISC herniation is the most prevalent diagnosis among the degenerative anomalies of the lumbar spine, and it is the most common reason for spinal surgery [1]. Despite the development of various surgical methods, open lumbar disc surgery is still the most common and major spinal intervention [2]. Many surgeons later developed microdiscectomy, and recently a less invasive approach to lumbar disc surgery, sequestrectomy, was developed for advantage of preservation of normal disc and end plate, maintaining disc height, minimally compromising inter-vertebral stability, improved back pain relief, a faster return to regular daily activities, and a shorter hospital stay [3].

Aim of study:

To assess the effects of lumbar disc fragmentectomy on pain alleviation, recovery, hospital stay, recurrence rate, and complications in patients with lumbar disc herniation (as discitis, post-operative back pain and persistent radicular pain).

Patients and Methods

This is a prospective study for analysis of twenty patients of lumbar disc prolapse that were surgically handled in the neurosurgery department at Cairo University hospitals between August 2019 and April 2020. This research looked at individuals of any age or gender who had a herniated lumbar disc fragment entangling the lumbar nerve root and were not responding to conservative treatment. We excludedcases with spinal canal stenosis, diffuse disc prolapse or instability of lumbar vertebrae.

Each case was evaluated for personal history, such as age, sex, and symptomatology, such as back discomfort and radicular pain. The researchers looked at pain in terms of its location, nature, severity (as measured by the visual analogue scale), distribution, duration, and responsiveness to medical therapy. The presence or absence of motor deficiency, sensory deficit, or cauda equine syndrome was examined in each case.

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Micro- fragmentectomy was used in twenty cases. The incision is made above the disc area that is causing the problem. The lumbodorsal fascia is incised, and the superior and inferior lamina enclosing the afflicted disc, the ligamentum flavum, and the medial facet are exposed through subperiosteal dissection. To preserve exposure, a weighted Williams or Taylor retractor is utilised. To further visualise the damaged areas, an operational microscope or loupes are employed. Depending on how accessible the disc herniation is, different portions of the medial facet and ligamentum flavum are resected. Kerrison rongeur is a tool that is used to remove tiny sections of laminae and facets. Finally, disc pieces in the epidural space are removed with a punch, the foraminotomy is completed, and then closure in layers.

Cases were assessed immediately after surgery, one month and three months after surgeryaccording to pain (back pain and radicular pain) improvement using visual analogue scale (VAS), according to presence or absence of neurological deficit or sphincteric affection and for detection of complications if occurred. MRI lumbosacral spine was done to all the cases after three months to assess recurrence rate at the same level of surgery.

Results

Twenty cases were indicated for surgery in our study for a herniated lumbar disc that entrapping lumbar nerve roots. The mean age of cases was 34.75 years with SD±15.2, 15 of them were male (75%), and 5 were female (5%). Regardingwork status, 11 of them (55%) were heavy workers, and 9 (45%) were relatively lighter workers. Half the included cases had L4/L5 disc prolapse, and the other half had L5/S 1 disc prolapse.

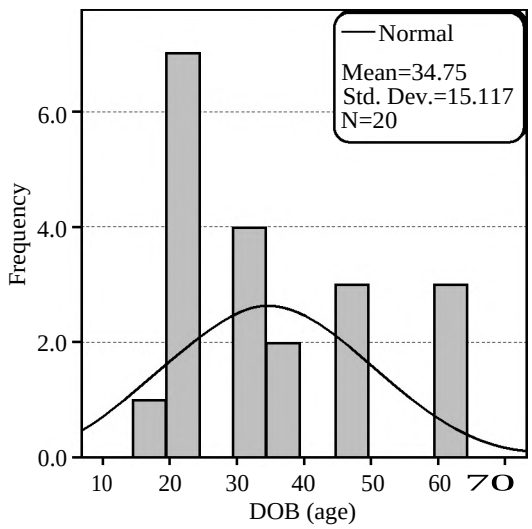

Fig. (1): Age distribution.

We assessed VAS for back pain and radicular pain each preoperative, immediately postoperative, one month and three months after surgery. Both back pain and radicular pain showed remarkable relief immediately after the operation compared to before the operation. Table (2). Describes mean and SD VAS score for back pain before, immediately postoperative, one month, and three months after surgery. Mean pain scores were 6.2±0.62 SD preoperative, 2.0±0.00 SD immediately postoperative, 1.9±0.98 SD one month postoperative, and 1.7±0.87 SD three months postoperative. Fig. (2). Describes the VAS score for back pain in relation to follow-up times. There was not marked relief in back pain immediately after surgery due to pain at wound incision and due to muscle separation. There was a marked relief in pain score of back pain after one month and three months after surgery.

Table (1): Assessment of back pain pre -operative, immediately post-operative 1&3 months after surgery.

Patient name	Pre-operative	Immediately post-operative	1 months post-operative	3 months post-operative
Case 1	6	2	0	0
Case 2	8	2	2	2
Case 3	6	2	2	4
Case 4	6	2	2	2
Case 5	8	2	2	6
Case 6	6	2	4	4
Case 7	6	2	4	6
Case 8	6	2	2	2
Case 9	6	2	2	2
Case10	6	2	2	2
Case 11	6	2	4	6
Case12	6	2	2	2
Case 13	6	2	2	0
Case 14	6	2	2	2
Case 15	6	2	2	0
Case 16	6	2	4	4
Case17	6	2	2	2
Case 18	6	2	2	2
Case 19	6	2	2	4
Case 20	6	2	2	2

Table (2): Mean and SD of back pain according to visual analogue scale (VAS score) preoperative, immediately postoperative, 1 month, and 3 months after surgery.

VAS for back pain	Mean	SD
Preoperative	6.20	0.62
Immediately postoperative	2.00	0.00
1 month postoperative	1.90	0.98
3 months postoperative	1.70	0.87

*VAS score assessed as Mean and Standard Deviation (SD).

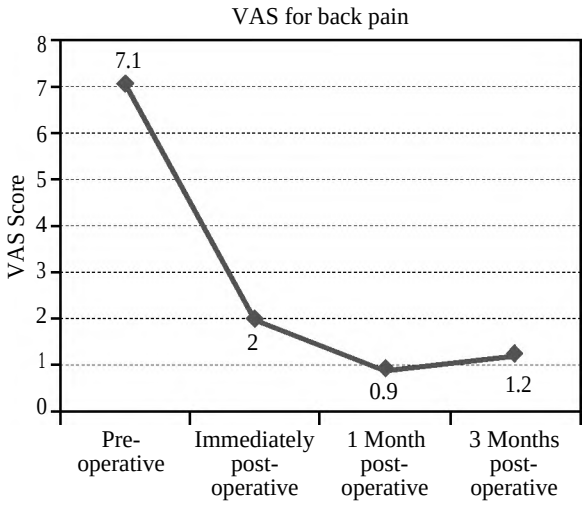

Fig. (2): VAS score for back pain over follow-up time.

We assessed mean visual analogue scale VAS score for radicular pain before, immediately post-operative, one month and three months after surgery (Table 3). Mean pain scores were 7.1 ±1.21 SD pre-operative, 2.0±0.00 SD immediately postoperative, 1.2±2.93 SD one month postoperative, and 0.9 ±1.52 SD three months after surgery. Fig. (3). Describes the VAS score for radicular pain in relation to follow-up times.

Table (3): Assessment of radicular pain according to (VAS score) preoperative, immediately postoperative, 1 month, and 3 months after surgery.

Patient name	Pre-operative	Immediately post-operative	1 months post-operative	3 months post-operative
Case 1	6	2	0	0
Case 2	10	2	0	0
Case 3	6	2	2	0
Case 4	8	2	0	0
Case 5	6	2	4	8
Case 6	8	2	0	0
Case 7	8	2	4	8
Case 8	6	2	0	0
Case 9	8	2	2	0
Case10	8	2	0	0
Case 11	8	2	4	8
Case12	6	2	0	0
Case 13	8	2	0	0
Case 14	6	2	0	0
Case 15	8	2	0	0
Case 16	6	2	0	0
Case17	6	2	0	0
Case 18	8	2	2	0
Case 19	6	2	0	0
Case 20	6	2	0	0

Table (4): Mean and SD of radicular pain according to (VAS score) preoperative, immediately postoperative, 1 month, and 3 months.

VAS score for radicular pain	Mean	SD
Preoperative	7.10	1.21
Immediately postoperative	2.00	0.00
1 month postoperative	1.20	2.93
3 months postoperative	0.90	1.52

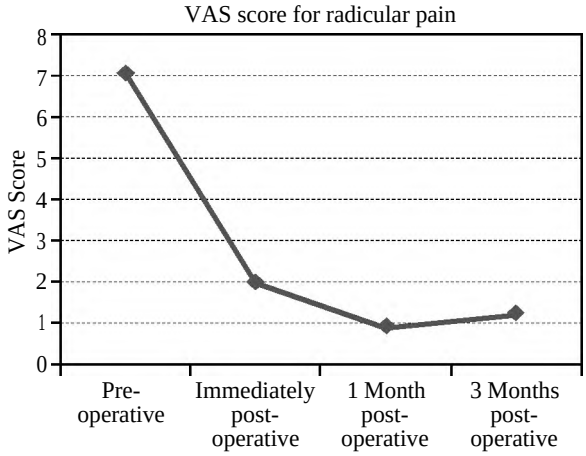

Fig. (3): VAS score for sciatica pain over follow-up time.

Table (5): Shows hospital stay, early recovery to daily activity and early recovery to work (data assessed as mean and SD).

Variable	Mean (days)	SD
Hospital stay	1.46	1.66
Early recovery to daily activity	2.3	1.44
Early recovery to work	14.3	5.02

Out of twenty cases in our study, two cases were complicated with foot drop; one of them developed weakness in dorsiflexion in a right ankle (grade two) immediately after surgery. MRI lumbosacral spine was done immediately and showed no evidence of disc fragment compressing the nerve root. After that, patient received steroids and neurotonic medications for three days, then discharged after one week without improvement. After two weeks, the patient visited the outpatient clinic for follow-up and power was partially improved in the right ankle to grade three. Three months after surgery, patient improved in power to grade four. The second case developed postoperative weaknesses in dorsiflexion of right ankle grade two. Postoperative MRI lumbosacral showed disc fragment compressing the nerve root that was managed by re-operation immediately with open discectomy. Immediately postoperative, patient did not improve. This patient also received steroids for three days and discharged after one week without improvement. After one month of surgery power started to improve to reach grade four three months after surgery.

Another two cases were complicated with an incidental intraoperative dural tears that caused minimal CSF leak intra-operatively, these dural tears were repaired by primary stitches, after removing the fragment and closing the fasciain watertight fashion with drain insertion, and no suction applied, postoperatively those patients were instructed to bed rest in a flat prone position. Acetazolamide tablets were prescribed for three days. The daily dressing showed no leak from the wound, an external drain was removed after three days. Both patients were discharged without any complains. After two weeks, patient presented to the outpatient clinic with clean wound without leak. MRI lumbosacral spine was done to the two cases three months after surgery and showed no evidence of CSF pseudomeningocele.

One case was complicated with surgical site superficial infection after one week of surgery, with elevated CRP, which improved with intravenous antibiotics and repeated dressing for ten days where stitches were removed at the outpatient clinic. MRI lumbosacral spine with contrast postoperative showed no evidence of deep infection (discitis).

Two cases in our study showed no improvement after surgery, with the persistence of same preoperative symptoms the postoperative imaging showed one of those cases had missed large fragment, compressing nerve root at the same level. A decision was taken to re-operate the patient by an open discectomy, immediately after surgery, patient improved. The other case showed insufficient postoperative decompression of nerve root, CT lumbosacral was done; it showed evidence of bone compression. A decision was taken for re-do by open discectomy.

Out of twenty cases, three cases developed recurrence of the same symptoms after three months. Imaging showed recurring of disc herniation at the same level of the previous operation, two of them exhibited intraoperative disc fragment compressing the nerve root managed by a microscopic discectomy, and the last one showed intraoperative significant disc fragment and instability that managed by open discectomy and fixation. Complications that occurred are illustrates in Fig. (4).

Table (6): Complications in our cases.

Complications of the operation	Number of patients (total=20)	Percentage
Drop foot immediately after surgery	2	10%
Dural tear	2	10%
Infection	1	5%
Persistence of symptoms	2	10%
Recurrence	3	15%

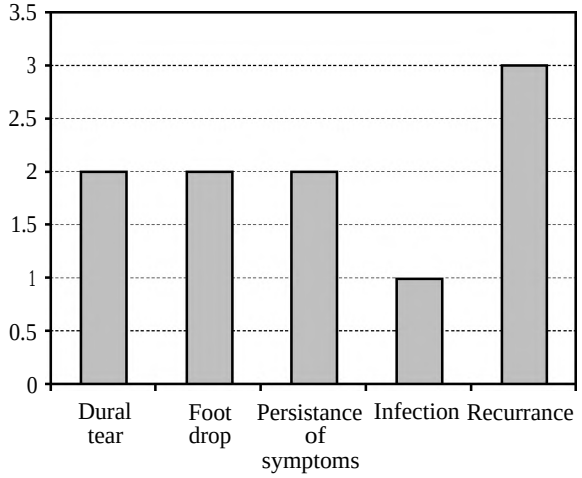

Fig. (4) Complications in study.

Discussion

Those aged 24 to 45 years old have the highest incidence of lumbar disc herniation, with patients aged 30 to 39 years old having the highest incidence of surgery **[4,5]**. Since the first instance reported in 1929 by Dandy, spine surgeons have struggled to treat lumbar disc degeneration surgically **[6]**. In 1934, Mixter and Barr described the lumbar discectomy technique, which was far from minimally invasive, requiring considerable lamina removal and forceful curettage of the end plate **[7]**. Casper and Yasargil pioneered the inter-laminar method in 1977, which included minimal laminotomies, undermining of facet joints, and cutting of ligamentum flavum, followed by evacuation of disc material. This micro-discectomy approach is considered the most popular for individuals who require surgery for symptomatic lumbar disc herniation **[8]**. The main advantage of the micro-discectomy technique is that of low incidence of re-herniation. As a result, surgeons are removing disc material from the intervertebral space in a pretty aggressive and substantial manner. However, a growing body of evidence suggests that disc height loss following surgery increases intervertebral instability **[9]**. The loss of disc height is accompanied by the loosening of ligaments and articular capsules, which can lead to segmental instability and, as a result, accelerate spondylosis, contributing to the "failed back syndrome" **[10]**. On the other hand, squestrectomy, only without discectomy, prevents this degenerative cascade. However, the risk of recurrence is debatable **[11]**.

Many articles compare microsurgical lumbar discectomy to open lumbar discectomy or aggressive lumbar discectomy to limited lumbar discectomy; however, there is minimal research comparing conventional microdiscectomy to free

fragmentectom [12]. In this study, sequesterectomy was used in every patient of lumbar discectomy from L2 to S 1. In these cases, the free disc fragment was discovered posterior to PLL. This decision was made totally intraoperatively by assessing the integrity of the PLL and the protruded disc, which is very subjective and dependent on the surgeon's skill. Our sequestrectomy inclusion criteria were similar to those used by Kast et al., in a previously published study [13].

In this study, the preoperative scores of back pain dropped significantly from 6.2 ±0.62 SD to 2.0±0.00 SD immediately postoperative, 1.9 ±0.98 SD one month postoperative, and 1.7 ±0.87 SD three months postoperative. The same was true for radicular pain which decreased markedly postoperatively from 7.1 ± 1.21 SD preoperative, 2.0 ± 1.52 SD immediately postoperative, 1.2 ±2.93 SD one month postoperative, and 0.9 ± 1.52 SD three months postoperative. Our results are comparable with Kast E. et al., [13,14] which enrolled 174 cases with 90 case in sequestrectomy group and 84 case in micro-discectomy group. Studies documenteda marked improvement in VAS of back and radicular pain for both microdiscectomy and sequestrectomy groups at follow-up 32 or more months after surgery [13,14]. Fakouri B. et al., found that postoperative VAS for both microdiscectomy and sequestrectomy were comparable, with 77 of 101 patients receiving microdiscectomy and the remaining 24 receiving microscopic sequestrectomy [15]. The proportion of patients taking analgesic medication at the time of follow-up was lower in fragmentectomy group than in the microdiscetomy group, but did not reach statistical significance. Our results are comparable with those of Barth et al., in their randomized controlled trial. They reported significantly less pain-related drug use at 2 years [16]. The VAS scores obtained 2 and 6 weeks after surgery were compared by Beak et al., Patients who had a fragmentectomy had less complaints of back pain the day following surgery and were able to walk more easily [17]. However, VAS scores after surgery did not differ significantly between the fragmentectomy and conventional microdiscectomy groups. The VAS scores for back and radicular complaints improved dramatically with both surgical techniques. In a meta-analysis by Ran et al., which enrolled 680 cases with 388 in the microdiscectomy group and 292 in the sequestrectomy group, adequate data of post-operative VAS for low back pain with mean and SD from five studies was provided [18]. Four studies of their included studies provided that significant improvement in VAS score for low back pain in sequestrectomy group than those of microdiscectomy group. Three studies with a total of 412 patients (224 in the microdiscectomy group and 188 in the sequestrectomy group) gave acceptable data on post-operative VAS for sciatica with mean and SD. There was no discernible change in any of them. Both surgeries had the same postoperative VAS for sciatica. In this study, the rate of reherniation in the fragmentectomy was 15%. Imaging showed recurrence of disc prolapse on the same level of the previous operation, two of them exhibited intraoperative disc fragment compressing the nerve root managed by a microscopic discectomy, and the last one showed intraoperative significant disc fragment and instability that managed by open discectomy and fixation. Similarly, Kast et al., and Thome et al., observed a 5% rate of reherniation in their sequestrectomy group due to recurrence disc herniation in their prospective controlled trial [13,19]. However, in a newly published randomised control experiment comparing lumbar microdiscectomy versus sequestrectomy, Barth et al., observed no significant difference in the rates of recurrence at 2 year follow-up [16]. However, the reported rate of reherniation following sequesterectomy was twice as high as ours and Kast et al., [13]. The majority of researchers believe that the fibrous ring's competency is a crucial element in affection of the rates of recurrence after sequestrectomy [13,15]. They thought that the low rate of re-herniation is due to their tight inclusion criteria, which required sequestrectomy in instances with an annular defect of 5mm or less and no substantial disc bulging. Furthermore, there is evidence to realize that the size of the annular tear is an important factor related with recurrence in traditional microdiscectomy [13]. In a retrospective review of 259 lumbar discectomies in which they classified lumbar fragment disc herniation according to the treatment protocol by Carragee et al., Wera et al., discovered a significant increase in reoperation rates due to reherniations in type 2 herniations, which are extruded or sequestrated disc fragments with large or massive annulus defects [20].

Revealed that the mean duration of hospital stay was 1.46 days and the standard deviation (SD) was ±1.66 days, while mean duration of early recovery to daily activity was 2.31 ± 1.4 SD days. Mean days for early recovery to work activity was 14.3 ±5.0 SD. Our study is compatible with Watters III WC et alstudy that suggest sequestrectomy may result in shorter operative time and quicker return to work [21]. According to Huang et al., the duration of hospital stay in these included studies ranged from 0.9 to 6.4 days in the sequestrectomy group, and 1.17 to 6.94 days in the microdiscectomy group, which is similar to our resuts [22].

In this study we reported an incidental intraoperative dural tears of 2 cases (10%) that caused minimal CSF leak intra-operatively, these dural tears were repaired by primary stitched, after removing the fragment and closing the muscle sheath "watertight" with drain insertion, and no suction applied, postoperatively those patients were instructed to bed rest in a prone position. Acetazolamide tablets were prescribed for three days. The daily dressing showed no leak from a wound, an external drain was removed after three days. We think that there 2 causes of higher incidence of dural tear firstly the narrow operative field and the experience of operating surgeon. Barth M. et al., did not address the incidence of duraltear as risk of reherination in hiscohort study that include 84 cases this because of its rare incidence on experienced surgeons **[16]**. According to Bernesmann et al., dural tear incidence is related to surgeon experience. Its incidence in the group of less experienced surgeons in 7.2% of cases, and with highly experienced surgeons in 0.8% (p<0.001) **[23]**. Most of robust studies in literature had found no statistical significance of incidence of dural tear between microdiscectomy and sequestrectomy **[24]**. In this case series we did not have any case of epidural hematoma following sequestrectomy same as Barth M. et al., study that includes 84 cases **[16]**.

There are two types of infections in lumbar disc surgery: Superficial and deep wound infections. Infection after lumbar disc surgery can be superficial or deep, extending to the epidural space or even the disc space, according to Postacchini F. et al., (discitis) **[25]**. According to the Postacchini F. et al., study, the incidence of disc space infection ranges from 0.13 to 0.9 percent, and it has been suggested that micro disc surgery has a greater infection rate than traditional open disc surgery due to the manipulations with the microscope over the open incision **[25]**. However, some studies revealed that with sequestrectomy, there is lower incidence of deep infection (epidural abscess and discitis) due to less manipulations, less time of surgery and exposure and that no violation of the disc space or its content occurs **[24]**.

In this study, Only one case was complicated with surgical site superficial infection after one week of surgery.

Conclusion:

In conclusion, with proper selection of patients according to well-defined criteria especially considering the competence of the annulus/posterior longitudinal ligament, microscopic sequestrectomy is superior with a shorter operative time, lower rate of perioperative complications, better relief of leg and bachpain, lower use of analgesic medication in the long term, specially that we realized from our results similar rates of recurrence. Our study main limiting facor was its small sample size and short term follow-up. Considering the limitations in this study, more prospective well-designed, randomized-controlled trials are needed to indentify our findings.

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تقييم الاستئصال الدقيق للجزء المتشظى فى علاج الانزلاق الغضروفى القطنى

المقدمة: يعد الانزلاق الغضروفى القطنى هو التشخيص الأكثر شيوعاً بين أمراض العمود الفقرى القطنى، وهو السبب الرئيسى لجراحة العمود الفقرى.

الأهداف: تقييم نتائج الاستئصال الدقيق للجزء المتشظى فى علاج الانزلاق الغضروفى القطنى فيما يخص التحسن الملحوظ فى ألام الظهر وسرعة عودة المريض للمارسة أعماله اليومية وقلة إحتياج المريض للأدوية المسكنة بعد العملية.

الوسائل: تم إجراء الجراحة الميكروسكوبية لاستئصال الجزء المتشظى من الغضروف فى عشرين حالة تعانى من الانزلاق الغضروفى القطنى.

الاستنتاج: استنتجت هذه الدراسة أن مجرد استئصال الشيظة الغضروفية فى الحالات التى يقيم بها الغلاف الغضروفى واربطه العمود الفقرى أنها سليمة له أفضلية عن الاستئصال الميكروسكوبى للغضروف من حيث قصر فترة الاجراء الجراحى واحتمالية أقل لحدوث مضاعفات ما بعد الجراحة و قصر فترة الاقامة فى المستشفى والنقاهه واحتمالية أقل لحدوث الام فى الظهر والساق، مع الاخذ فى الاعتبار أن كلا الاجرائين لهما نفس اجتمالية حدوث ارتجاع غضروفى تفتقر هذه الدراسة لعدد من الحالات وفترة أطول للمتابعة، لذا نحتاج لدراسة عدد أكبر من الحالات لفترة أطول لتأكيد هذه النتائج.