Retrospective Study

Percutaneous Endoscopic Resection of Lumbar Discal Cyst

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Disclaimer: This study was supported by the Henan Provincial Medical Science and Technology Tackling Program Joint Project (LHGJ20230041). All patients in this study signed informed consent forms and were approved by the Ethics Committee of Henan Provincial People's Hospital (2022, ethical review No.1-233).

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Article received: 03-30-2024
Revised article received: 05-15-2024
Accepted for publication: 08-02-2024

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Background: Discal cysts, an uncommon condition, can replicate the characteristic signs typically linked to a herniated lumbar disc, encompassing discomfort in the lumbar region and neuralgia that extends along the nerve paths, thereby complicating the process of distinguishing the discal cyst from other conditions. Consensus on the treatment of this disease remains elusive, and the best treatment for it is still a matter of controversy. In numerous past reports, this disease has been treated through either open or microscopic surgical approaches.

Objectives: The aim of this study is to assess the therapeutic efficacy and safety of a minimally invasive endoscopic surgery technique in the treatment of lumbar discal cysts.

Study Design: We conducted a retrospective observational analysis.

Setting: This research was initiated with a group of patients selected from the Spinal Surgery Unit at the Henan Provincial People's Hospital.

Methods: From March 2017 to May 2021, a minimally invasive endoscopic procedure was executed on a cohort of 7 male patients (average age: 30.86 ± 5.24 years), each diagnosed with discal cysts, within our spinal surgery division. The efficacy of the treatment was gauged by pre- and postoperative assessments that used the Visual Analog Scale (VAS) and the Oswestry Disability Index (ODI). Furthermore, the ultimate clinical efficacy of the procedure was appraised in accordance with the revised Macnab criteria.

Results: The patients reported a prompt and significant relief of symptoms after the surgical removal of the lumbar disc lesions, with no cases of recurrence noted during the follow-up period. A significant drop was observed in the VAS score for lower limb pain, declining from a preoperative mean of 6.86 ± 1.35 to 1.57 ± 0.53 at the final evaluation ($P < 0.05$). In tandem with this finding, a marked decrease in the ODI score was noted, with a reduction from 69.14 ± 10.76 before surgery to 10.29 ± 5.59 at the concluding review ($P < 0.05$). The postoperative VAS and ODI scores collectively pointed toward substantial improvements in patients' conditions. When assessed according to the revised Macnab criteria, the outcomes were distributed as follows: 4 patients (57.1%) achieved excellent results, 2 (28.6%) had very good results, and one (14.3%) had a fair result, totaling 6 patients (85.7%) with satisfactory outcomes. No severe complications or recurrences were identified during the postoperative monitoring phase.

Limitations: This observational retrospective study was based on a convenience sampling that involved a limited number of patients.

Conclusions: Percutaneous endoscopic resection emerged as a micro-invasive and secure surgical approach for the management of lumbar discal cysts.

Key words: lumbar discal cyst, percutaneous endoscopic resection, minimally invasive

Pain Physician 2024: 27:E873-E879

Chiba et al have confirmed that discal cysts are unique lesions, distinct from other cystic entities that occur in the lumbar spine (1). This uncommon condition can present with symptoms such as lower back pain and radiculopathy. Symptoms of lumbar discal cysts often parallel those observed in cases of lumbar disc herniation (2). Various therapeutic strategies for managing discal cysts have been reported, encompassing pharmacological pain relief, rehabilitative physical therapy, administration of steroid injections, computed tomography (CT)-assisted drainage of the cysts, and the surgical removal of cysts via endoscopic techniques (3-5). Nonetheless, there is no universally agreed-upon surgical protocol for this condition. Historically, traditional open procedures or microscopic methods have been the mainstay of treatment for discal cysts (6). The search for a safer and less invasive surgical option has led to the exploration of percutaneous endoscopic surgery, which has been used effectively in treating lumbar disc herniation by preserving the paraspinal structures and avoiding injury to the back muscles (7). However, most reports regarding the treatment of discal cysts with percutaneous endoscopic surgery have consisted primarily of case reports (8,9). In our study, we report the medical results of a series of 7 patients who experienced symptoms caused by lumbar discal cysts and were treated using a percutaneous endoscopic technique characterized by minimal invasiveness, with the objective of reducing the extent of surgical intrusion. The primary objective of this study is to assess the therapeutic effectiveness and safety profile of the minimally invasive percutaneous endoscopic procedure when used for treating lumbar discal cysts.

Methods

Patients and Methods

Between March 2017 and May 2021, our study included 7 men who presented with symptomatic radiculopathy attributed to lumbar discal cysts and were treated with percutaneous transforaminal endoscopic surgery (Table 1). Each patient reported unbearable low back discomfort and experienced unilateral pain radiating to the lower limbs, common symptoms observed in cases of lumbar disc herniation. The medical diagnosis of each patient was affirmed through both magnetic resonance imaging (MRI) examinations and observations made during surgery. The MRI scans uniformly showed a saclike structure adjacent to the compromised lumbar disc, which was recognized through its low intensity signal on T1-weighted sequences and high intensity signal on T2-weighted sequences (Fig. 1). The inclusion criteria encompassed the following: (1) lumbar discal cyst without segmental instability, (2) intolerable unilateral radiating pain in the leg, and (3) ineffectiveness of conservative treatment. The exclusion criteria included: (1) prior history of lumbar surgery, (2) presence of systemic or lumbar inflammation, and (3) a combination of severe illness and inability to tolerate surgery.

The patients' mean age was 30.86 ± 5.24 years (range: 21-36 years). Three patients had pain in the left lower limb, and 4 patients had right lower limb pain. Among the patients, 2 had L3-L4 involvement, 3 had L4-L5 involvement, and 2 had L5-S1 involvement. The mean symptom duration from the onset to the surgical procedure was 4.29 ± 2.50 months, with a variation from one to 8 months. Operative time was recorded at 83.14 ± 13.56 minutes and extended from 65 to 103 minutes. Postoperative follow-up for all patients extended for a minimum of 12 months, with an average duration of 15.43 ± 2.94 months (from 12 to 20 months).

Anesthesia

Sedatives such as dexmedetomidine and local anesthesia (1% lidocaine) were used in all cases. All patients were positioned in a lateral recumbent posture, with the symptomatic lower limb positioned superiorly, on a radiolucent carbon fiber operating table. All surgical puncture procedures were guided by C-arm fluoroscopy. The patients were placed in a light sleep state designed to endure throughout the procedure, enabling them to awaken promptly upon experiencing acute pain and thus preventing potential nerve root damage.

Surgical Procedure

The surgical procedure closely resembled the standard percutaneous endoscopic transforaminal approach (10) but added C-arm-guided discography. The point of skin penetration, situated roughly 8 to 14 centimeters from the body's midline, was selected in accordance with the positioning of the lumbar discal cyst. After the induction of local infiltration anesthesia, a C-arm fluoroscope was used to direct an 18-gauge needle percutaneously to the designated site within the intervertebral disc. A total of 2 mL of a contrast medium, a mixture containing iodohexanol and methylene blue, was injected (Fig. 2). Lower limb radiation

Table 1. *Patient demographics and characteristics.*

Case	Gender	Age (Years)	Direction	Level	Symptom Duration (Months)	Surgery Duration (Minutes)	Follow-up (Months)	Complications
1	male	35	right	L4-5	6	72	15	
2	male	33	left	L5-S1	1	88	12	transient paresis
3	male	36	right	L3-4	8	83	16	
4	male	27	right	L4-5	3	65	18	
5	male	31	left	L3-4	4	96	15	hypesthesia
6	male	21	left	L5-S1	2	103	20	
7	male	33	right	L4-5	6	75	12	
Value		30.86 ±5.24 (21-36)	left 3 (42.9) right 4 (57.1)	L3-4 2(28.6) L4-5 3(42.9) L5-S1 2(28.6)	4.29 ± 2.50 (1-8)	83.14 ± 13.56 (65-103)	15.43 ± 2.94 (12-20)	2 (28.6)

Values are presented as mean ± SD (range) or as a percentage (%).

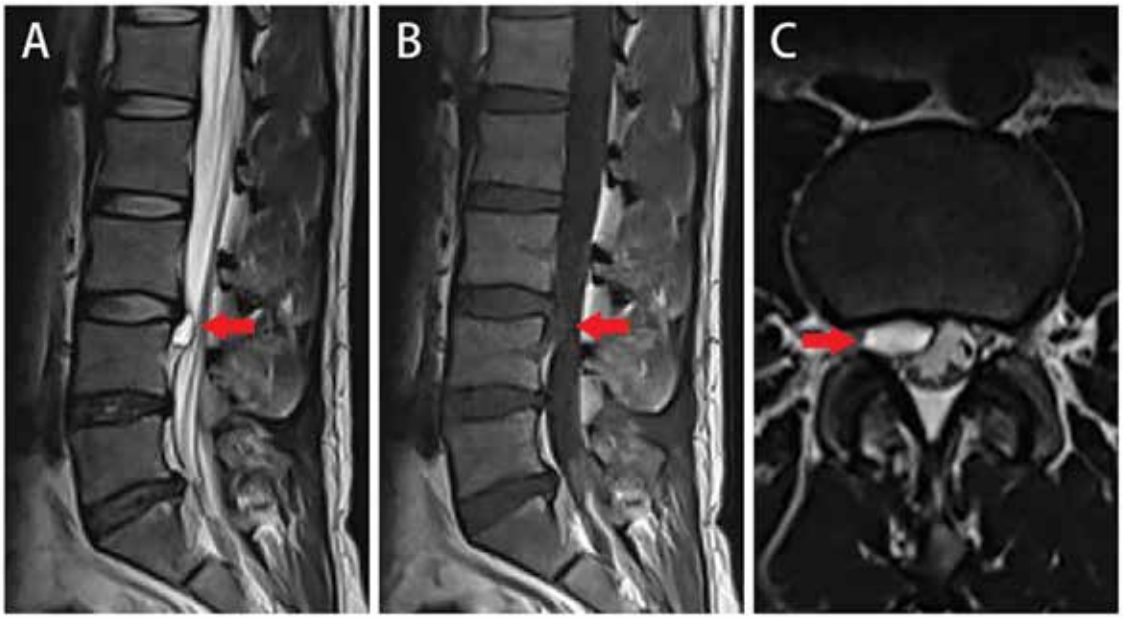

Fig. 1. *Preoperative MRI scans.*
A. T2-weighted sagittal imaging: a cystic lesion, originating from the L3-4 intervertebral disc and extending caudally, demonstrates a high-intensity signal (arrow).
B. T1-weighted sagittal imaging: the same sagittal plane with the T-2 weighted imaging (arrow).
C. T2-weighted axial imaging: the cyst, situated on the right side of the spinal canal, compresses the dura mater and nerve roots (arrow).

pain could then be observed. After the needle was withdrawn, the tip made contact with the indentation of the vertebral pedicle on the lateral x-ray, situating it securely between the inner margin of the pedicle and the midline on the posteroanterior view. A 0.8-mm guide wire was substituted for the needle, followed by a skin incision measuring approximately one centimeter. The catheters were gradually expanded and placed in sequence along with the working cannula. Next, the guide wire and the dilated catheters were removed, making way for the successive insertion of the circular saw and the endoscope into the working cannula. With endoscopic guidance, the circular saw was employed to excise a section of the articular pro-

cess, effectively broadening the intervertebral foramen. Discal cysts commonly have an attachment to the intervertebral disc (9). Thus, the removal of both the discal stalk and the cyst's capsule is indispensable to the surgical process. In cases that require disc decompression to decrease the probability of nerve-related complications and root damage, it is recommended to perform a decompressive discectomy before the cystectomy (11). As Sang et al did in their own study, we, too, encountered frequent bleeding during the cystectomy process, which was likely due to the cyst's adherence to surrounding tissues (11). This bleeding was efficiently controlled using bipolar coagulation and saline lavage. Ultimately, the compromised nerve root was restored to full mobility, and there was a significant improvement in the patient's preoperative symptoms (Fig. 3). After surgery, MRI and pathological examinations were conducted for all patients.

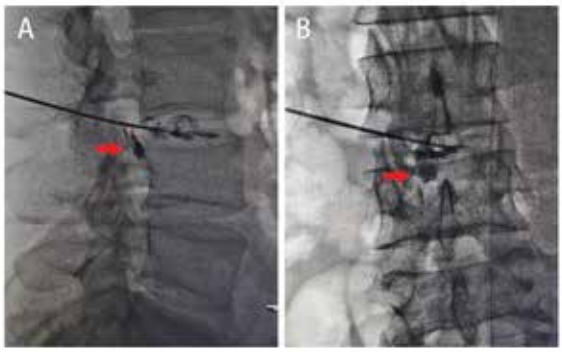

Fig. 2. *Imaging of the patient's discography.*
A. Lateral projection. The contrast medium is observed to have exited from the intervertebral disc and fully occupied the cystic space (indicated by the arrow).
B. Posteroanterior projection. The cyst is situated on the right aspect of the spinal canal (indicated by the arrow). Notably, in this study, the cysts did not extend across the median plane.

Evaluation

Each patient's demographic and medical information, including age, gender, location of discal cyst, duration of symptoms, encountered complications, and clinical presentation both before and after the surgical procedure, were carefully recorded and presented in detail in Table 1. Assessments were performed using MRI before the operation, immediately afterward, and at 6 months postoperatively. Additionally, pain intensity and the degree of disability were evaluated at multiple intervals: the day before surgery, one day and 6 months after the operation, and at the ultimate follow-up, utilizing the Visual Analog Scale (VAS) for pain and the Oswestry Disability Index (ODI) for disabil-

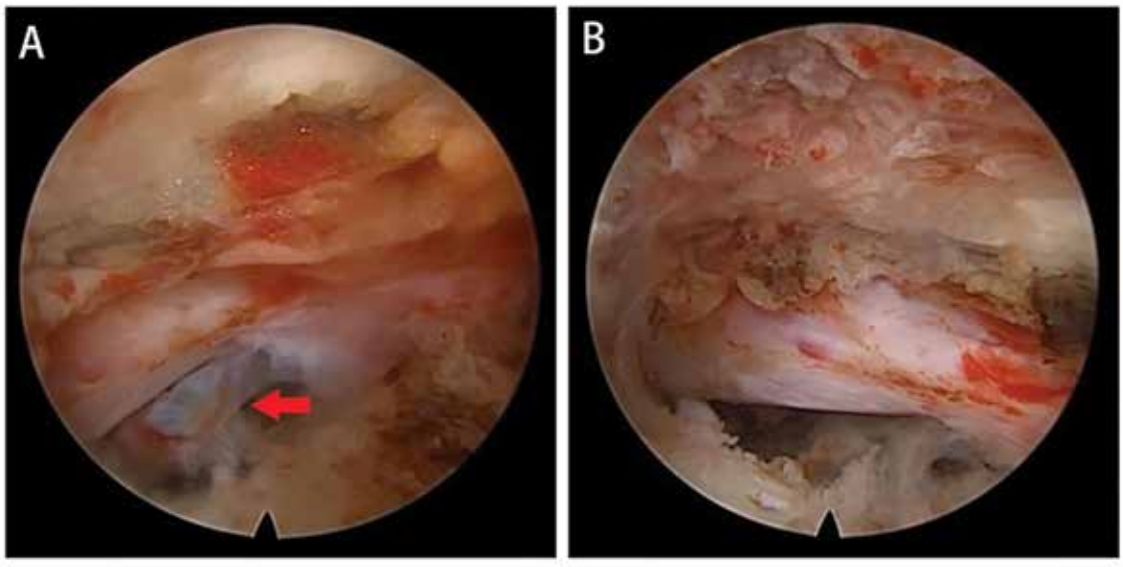

Fig. 3. *Endoscopic intraoperative views.*
A. The nerve root is compressed by the discal cyst (marked by the arrow), a result of adhesion.
B. Following the excision of the discal cyst, the nerve root is released from compression.

ity assessment. At the end of the observation period, the clinical effectiveness of the surgical treatment was appraised according to the revised Macnab criteria (12). Postoperatively, a histopathological analysis of the removed cyst wall was also undertaken.

Statistical Analysis

The analysis of the data was conducted using IBM® SPSS® Statistics 26.0 (IBM Corp.). The outcomes are depicted as the mean value accompanied by the SD (mean ± SD). A juxtaposition of the preoperative and postoperative data was executed using statistical evaluations, carried out using Student's t-test. The criterion for statistical significance was established as a *P*-value below the threshold of 0.05.

Results

Patients observed improvements in their lower limb pain immediately following the surgery. One-day postoperative MRI scans demonstrated the cysts' disappearance and the alleviation of nerve root compression. Six months later, MRI scans indicated no recurrence of the cysts and no advancement in disc degeneration or herniation. A pronounced decrease in the leg pain scores as measured by the VAS was noted, with the values declining from an initial mean of 6.86 ± 1.35 to 1.57 ± 0.53 at the final review, achieving statistical significance ($P < 0.05$), as outlined in Table 2. Additionally, the Oswestry Disability Index (ODI) scores demonstrated a substantial reduction, dropping from 69.14 ± 10.76 preoperatively to 10.29 ± 5.59 at the final follow-up ($P < 0.05$), as detailed in Table 3. The clinical efficacy at the conclusion of the follow-up was appraised using the revised Macnab criteria, yielding the following results: 4 patients (57.1%) obtained excellent outcomes, 2 patients (28.6%) had good outcomes, and one patient (14.3%) had fair results. These findings culminated in a satisfactory outcome for 6 patients (85.7%) in total. During the follow-up period, no serious complications or recurrences were observed. One patient (14.3%) experienced transient leg paresis, which gradually improved and resolved within one-month after surgery following treatment with mecobalamin and gabapentin. Unfortunately, one patient (14.3%) experienced persistent hypesthesia.

In all cases, the excised cyst wall was subjected to pathologic examination, revealing a composition primarily of fibro-collagenous tissue and fibroblast proliferation, without the presence of lining cell layers (Fig. 4).

Discussion

The discal cyst, sometimes referred to as an extradural cyst, is typically connected to the adjacent intervertebral disc (1,13). Discal cysts are usually more prevalent among young men, while intraspinal cysts from the ligamentum flavum or facet joints are more likely to affect elderly individuals with spinal degeneration or instability (1,14,15). These cysts often mimic the symptoms of a herniated disc, such as lower back pain and unilateral radiculopathy. Despite the existence of numerous hypotheses concerning the origin of discal cysts, the exact causative pathway remains a subject of controversy (1,13,16). The research conducted by Kono and colleagues has emphasized the potential origin of these cysts in the focal deterioration of the intervertebral disc, which can result in a fluid buildup akin to that observed in meniscal cysts affecting the knee or the synovial cysts found in the facet joint (13). Our

Table 2. *VAS scores*.

Time	VAS Score	*P* value
One day preoperative*	6.86 ± 1.35	
One day postoperative	2.86 ± 1.07	*$P = 0.000$
6 months postoperative	2.14 ± 0.69	*$P = 0.000$
Final follow-up	1.57 ± 0.53	*$P = 0.000$

VAS scores are represented as mean ± SD. Analysis using paired t-tests. *: compare with one day preoperative.

Table 3. *ODI scores*.

Time	ODI Score	*P* value
One day preoperative*	69.14 ± 10.76	
One day postoperative	17.71 ± 6.97	*$P = 0.000$
6 months postoperative	13.14 ± 4.88	*$P = 0.000$
Final follow-up	10.29 ± 5.59	*$P = 0.000$

ODI scores are presented as sample mean ± SD. Analysis using paired t-tests. *: compare with one day preoperative.

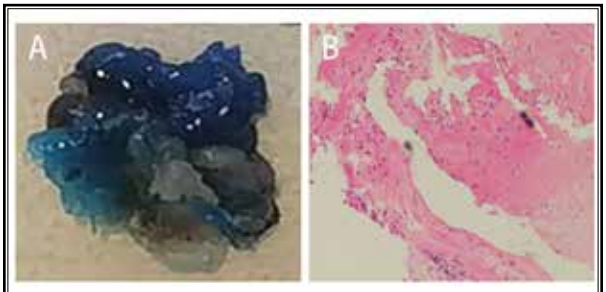

Fig. 4. *A. The discal cyst stained with methylene blue. B. Histopathologic appearance of the discal cyst (hematoxylin and eosin, ×100).*

investigation, encompassing a comprehensive analysis of preoperative radiographic and histopathological data, indicates a correlation between the emergence of discal cysts and the occurrence of disc protrusion, a conclusion that corroborates the observations made by Kono et al (13).

MRI is recognized as a crucial tool for diagnosing lumbar discal cysts, and existing scholarly works support the technique's importance (17). The lesion exhibits lower signal levels when imaged using T1-weighted sequences and higher signal levels when T2-weighted sequences are used. Typically, the variations in signal intensity reflect the cyst's fluid content. The periphery of the cyst is often observed to be magnified on contrast-enhanced MRI scans. A discal cyst can be distinguished from a herniated disc by identifying the connection between the cyst in relation to the intervertebral disc space. The invasiveness of the procedure notwithstanding, discography has been instrumental in diagnosing discal cysts and verifying the linkage between the cyst and the associated intervertebral disc (1). In our study, the preoperative diagnosis was ascertained through a combination of clinical signs, neurological assessments, MRI, and computed tomography (CT) imaging of the lumbar region. Intraoperatively, discography was conducted prior to the excision of the cyst to offer definitive verification (Fig. 2).

Treatment strategies for discal cysts are still a subject of controversy (18). While conservative management is often recommended as the first-line approach, surgical intervention is considered when patients develop progressive radiculopathy or neurological deficits. Studies indicate that surgical excision of symptomatic lumbar discal cysts can result in significant pain alleviation (9,11). A spectrum of surgical approaches has been documented for the treatment of these cysts, encompassing computed tomography (CT)-guided drainage, microsurgical excision, and endoscopic surgical techniques. Koga et al have achieved promising clinical results from employing CT-guided percutaneous puncture and supplementing it with steroid injections (19). The methods used by Koga and colleagues can achieve satisfactory results in some cases. However, this treatment method carries the risk of nerve root damage and cyst recurrence.. Surgical resection not only removes the cyst but also decompresses the nerve, which is beneficial for alleviating pain. Chiba et al were pioneers in using microscopic resection for discal cysts (1), and Ishii et al (6) described a successful case of using an endoscopic approach. The method presents a multitude of beneficial aspects, including the maintenance of spinal stability, a reduction in hemorrhagic complications, a condensed period of hospitalization, an expedited pace of recuperation, and a diminished level of discomfort after surgery (20). However, most studies on this technique have been limited to case reports (9). In our study, a percutaneous endoscopic transforaminal approach was used to treat 7 patients with discal cysts, resulting in satisfactory outcomes for 6 patients (85.7%), with only one patient reporting hypesthesia.

The decision to resect the associated intervertebral disc along with the cyst is still debated. Some studies have reported favorable outcomes and no recurrence after cystectomy without concurrent discectomy (18,21). However, many specialists propose that the surgical excision should encompass not only the cyst itself but also the associated intervertebral disc. This broader surgical approach is believed to potentially lower the likelihood that the condition will reoccur (5,11,22). Another reason for performing a partial discectomy is to prevent the formation of postoperative disc pseudocysts, which can result from inflammation at the surgical site. Discal cysts often contain granulation tissue around the exterior layer of the cystic disc fragments, which may lead to pseudocysts and a recurrence of symptoms. In our research, we also conducted a partial discectomy on the affected intervertebral disc. Postoperative monitoring throughout the follow-up phase did not reveal any severe complications or instances of cyst recurrence.

Conclusion

To summarize, the percutaneous endoscopic technique emerges as a secure and minimally invasive procedure for addressing symptomatic lumbar discal cysts, offering a practical surgical choice for this uncommon ailment.

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