AN OBSERVATIONAL STUDY OF 79 CASES OF INEFFECTIVE LUMBAR MINIMALLY INVASIVE TREATMENT: CAUSE ANALYSIS AND TREATMENT STRATEGIES

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ABSTRACT

Objective: *Although there are many minimally invasive treatments for lumbar degenerative diseases, some cases were ineffective. Herein, we summarized the clinical symptoms and treatment methods of such cases.*

Methods: *A retrospective analysis of 79 ineffective cases after minimally invasive surgery between January 2016 and June 2019. All cass underwent X-ray, MRI and CT examinations. Among them, 61 cases showed residual lumbar disc herniation or lumbar spinal stenosis, and were included in Group 1. They underwent transforaminal lumbar interbody fusion (TLIF) surgery of the corresponding segment. 18 patients showed no obvious lumbar disc herniation or lumbar spinal stenosis. These 18 patients underwent corresponding segmental nerve root block, of which 15 patients showed significant remission and were included in Group 2. Thereafter, corresponding segmental TLIF surgeries were performed. Three cases had no obvious remission after treatment of nerve root block, and were conservatively treated. A total of 76 patients were enrolled. The average follow-up time was 12 months. The effects of revision surgery were evaluated with Visual Analogue Scale (VAS) for low back and leg pain and Oswestry Disability Index (ODI).*

Results: *A total of 79 patients in both groups underwent TLIF at the corresponding levels. Most cases in Group 1 showed nerve root adhesion and edema. All cases in Group 2 showed nerve root adhesion and edema. VAS and ODI scores were significantly improved 1 day before revision and 2 weeks, 3 months, 6 months and 12 months after revision ($p<0.05$).*

Conclusion: *Some cases were ineffective after minimally invasive surgery. Most of which were found imaging abnormalities, while a few of which were found no obvious imaging abnormalities. When conservative treatment failed, nerve root block could help to diagnose. The TLIF surgery could fully release the adhered nerve roots, which were effective.*

Keywords: *Minimal invasive surgery, inefficacy, revision surgery, never root adhesion.*

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Introduction

While the number of patients who undergoing minimally invasive surgery of the lumbar spine is increasing annually, the number of ineffective minimally invasive surgery is also increasing significantly. The common symptoms of such cases include radiating pain in the lower extremities and intermittent claudication. The minimally invasive treatments for the lumbar spine include lumbar intervertebral disc collagenase injection therapy, lumbar intervertebral disc ozone injection therapy, lumbar intervertebral disc radiofrequency ablation therapy, and nucleus pulposus resection under foraminal microscope or lumbar canal decompression in China. Between January 2016 and June 2019, X-ray, MRI, and CT examinations were performed on these 79 cases, and some of which underwent revision surgery. Visual analogue scores (VAS) and Oswestry Lumbar Spine Dysfunction Index (ODI) scores were used to evaluate the effect of revision surgery.

Materials and methods

General information

Inclusion criteria:

Between January 2016 and June 2019, 79 cases who underwent minimally invasive treatment for lumbar disc herniation or lumbar spinal stenosis (L3-S1) showed persistent lower extremity radiation pain and intermittent claudication, which were not improved after taking oral nonsteroidal anti-inflammatory drugs (NSAIDs).

Primary minimally invasive lumbar surgery included collagenase injection, ozone injection, radiofrequency ablation of the lumbar disc, foraminal resection of the lumbar nucleus pulposus, or decompression of the spinal canal. The main symptoms were lower extremity radiotherapy pain and intermittent claudication (duration, 2 weeks to 14 months), with or without lower back pain and numbness of the lower extremity. 61 cases showed lumbar disc herniation and lumbar canal stenosis on imaging, and lumbar TLIF were performed on the corresponding segments (1 or 2 segments).

These cases were included into Group 1. There was no obvious lumbar disc herniation, lumbar canal stenosis or lumbar spondylolisthesis instability on imaging in 18 patients. After corresponding segmental nerve root block, 15 patients showed significant remission, and subsequently corresponding segmental lumbar TLIF was performed. They were included into Group 2. The final surgery for all patients was performed by the same group of doctors.

This study was approved by ethics committees regarding Human Research of Wuhan Fourth Hospital, Pu Ai Hospital, Tongji Medical College, Huazhong University of Science and Technology. All experiments were performed following the relevant guidelines and regulations of the Institutional Ethics Committee and the Declaration of Helsinki, 1975. All patients provided written informed consent.

Surgical methods

Group 1 revision surgery

According to the method of Chin et al., the patients were in prone in general anesthesia, and the surgical location was determined by C-arm[1].

The posterior median incision was made, Decompression and intervertebral fusion were performed by conventional methods. Significant disc herniation or lateral stenosis were observed during the operation, and nerve root adhesion was also found in most cases. The nerve root was completely released intraoperatively.

Group 2 revision surgery:

Intraoperatively, no obvious disc herniation, compression of the nucleus pulposus or lateral stenosis was observed. However, severe nerve root adhesion was observed, which could adhere to annulus fibrosus, ligamentum flavum, or both. Small pieces of free cartilage endplate were also observed at the nerve root adhesion in three cases. The range of motion of nerve roots was found to be less than 1 mm by nerve retractors.

The nerve root was carefully separated from the annulus fibrous disc and ligamentum flavum and released completely, and the nerve root could be moved easily.

Observation indexes

Visual analogue scale (VAS) and Oswestry Disability Index (ODI) scores were recorded at 1 day before surgery and 2 weeks, 3 months, 6 months and 12 months after surgery.

Lasegue sign examinations were performed routinely 1 week preoperatively and 2 weeks postoperatively.The pain score was evaluated by visual analog scoring method. The score range was 0~10 points. The higher the score, the higher the degree of pain. Activities of daily living often account for the scoring standard of the index: it is composed of 10 questions, and the highest score of each question is 5 points. The higher the score, the higher the degree of daily living disorder of patients.

Statistical analysis

SPSS 12.0 was used for statistical analysis, and analysis of variance was used for comparison of the results at different time points. A p-value <0.05 was considered to be statistically significant.

Results

All the operations were successfully completed, and the wounds healed in the first stage. One case developed dural tear and CSF leakage, and was extubated after five days of drainage, and the wound healed in the first stage. Postoperative complications such as radicular pain, infection and delayed wound healing were not observed in any case.

The most of cases in Group 1 and Group 2 showed positive Lasegue sign one day before surgery and negative Lasegue sign two weeks after surgery.

VAS and ODI scores were significantly improved in Group 1 and Group 2 ($p<0.05$). The improvement was most significant at 3 months after operation, and gradually plateaued at the later stage. The preoperative symptoms of Group 1 were more severe than those of Group 2, and the postoperative improvement was more obvious, which could be related to the removal of residual discs and the management of spinal stenosis. See Tables 1 and 2.

	Group 1								
	VAS for limb	t	p	VAS for lumbar	t	P	ODI (%)	t	P
Before revision surgery	7.88± 0.74			4.12± 0.76			39.80± 4.71		
2 weeks after surgery	5.15± 0.73	24.048	0.000	3.78± 0.64	2.768	0.008	34.87± 2.66	10.677	0.000
3 mouths after surgery	4.25± 0.63	29.997	0.000	3.10± 0.57	9.449	0.000	29.80± 2.96	28.365	0.000
6 mouths after surgery	43.57± 0.50	37.47	0.000	2.67± 0.48	12.604	0.000	25.63± 3.18	31.02	0.000
12 mouths after surgery	3.22± 0.42	38.02	0.000	2.55± 0.50	16.814	0.000	21.70± 3.37	28.584	0.000

Table 1: Patients with residual lumbar disc herniation or lumbar spinal stenosis.

	Group 2								
	VAS for limb	t	p	VAS for lumbar	t	P	ODI (%)	t	P
Before revision surgery	7.64± 0.74			3.64± 0.93			30.43± 4.31		
2 weeks after surgery	4.79± 0.97	10.408	0.000	3.21± 0.58	2.482	0.028	27.29± 2.89	4.38	0.001
3 mouths after surgery	4.07± 0.62	17.678	0.000	3.14± 0.36	2.463	0.029	24.86± 2.57	7.615	0.000
6 mouths after surgery	3.57± 0.51	14.216	0.000	2.86± 0.36	2.797	0.015	21.29± 2.02	11.776	0.000
12 mouths after surgery	3.07± 0.62	13.323	0.000	2.71± 0.47	3.484	0.004	18.86± 1.51	10.047	0.000

Table 2: Patients without obvious lumbar disc herniation or lumbar spinal stenosis

Discussion

Minimally invasive treatment of lumbar spine is initially chosen by many patients. At present, the methods of minimally invasive treatments for the lumbar spine in China include lumbar intervertebral disc collagenase injection therapy, lumbar intervertebral disc ozone injection therapy, lumbar intervertebral disc radiofrequency ablation therapy, and nucleus pulposus resection under foraminal microscope or lumbar canal decompression.

However, all minimally invasive treatments have limitations, such as surgical experience, limited operation space, inadequate view, and inadequate decompression[2, 3]. If excessive articular process was removed for decompression, the stability of spine was affected. Overmuch operations cause excessive surrounding tissue damage[4, 5].Some treatments, such as collagenase injection, lumbar intervertebral disc ozone injection, and radiofrequency lumbar disc ablation, remain controversial[6-10].

In this study, cases in Group 1 showed residual lumbar disc herniation or spinal stenosis on lumbar CT and lumbar MRI, at the same level as the first minimally invasive lumbar surgery. Twenty of these patients may have chosen an inappropriate surgical procedure (collagenase injection, ozone injection, or radiofrequency ablation). Segment-appropriate TLIF were performed, and the nerve root were released completely. In most cases, nerve root adhesions could be intraoperatively identified. Cases in Group 2 showed symptoms of lower limb radiation pain or intermittent claudication, although there was no significant residual disc herniation or spinal stenosis on CT and MRI. 15 cases were successfully treated by corresponding level spinal nerve root block, 5 of these cases were performed collagenase injection, ozone injection or radiofrequency ablation during the first minimally invasive surgery, and 10 cases were performed foraminal endoscopic discectomy or spinal decompression. These 15 cases were perform TILF revision surgery, and were found adhesion of nerve roots during the revision surgery. Although some surgeons believe that revision surgery can be adopted with foraminal endoscopic surgery, TLIF has a more reliable effect[11-13]. Compared with foraminal resection of the nucleus pulposus or decompression of the spinal canal, TLIF has more operating space, which makes it easier to find hidden nerve root adhesions, and more thorough release of the nerve root adhesions. Moreover, for some patients with low back pain before revision, TLIF can partially alleviate the symptom.

During revision surgery of the lumbar spine in Group 2, the nerve roots were carefully explored with a nerve probe. The nerve roots were severely adhered to the annulus fibrosus of the disc, the dura mater, or both, and could not be easily moved with the nerve retractor than 1 mm. After release, all nerve roots could be moved easily. Postoperative lower extremity radiotherapy pain and claudication symptoms were significantly relieved. Therefore, radiation pain and claudication symptoms of lower extremity after minimally invasive lumbar surgery were related to nerve root adhesion, and revision

surgery to release the nerve root was effective. Some surgeons believe that possible causes of recurrent lower extremity radiation pain without obvious nerve root compression on imaging, include chemical radiculitis, postoperative arachnoiditis, and postoperative epidural fibrosis. Selective intradural dorsal rhizotomy (SIDR) was effective[14]. In this study, there was no evidence of postoperative arachnoiditis on examination before revision, and most cases in Group 1 and all cases in Group 2 were found nerve root adhesion, which was consistent with Bakker et al. The cause of nerve root adhesion may be associated with local inflammation, since lumbar ozone injection can lead to IL-1beta, IL-6, IL-8 and the increase of TNF-alpha. The intervertebral disc ozone stimulus, inflammatory response and nerve root adhesion cause radiation pain in the lower extremities[15, 16].Local infection is likely to occur after ozone treatment of lumbar spine, may cause fibrous adhesions[17]. Collagenase could dissolve the nucleus pulposus, annulus fibrosus and endplate and bring the intervertebral disc debris, the adhesive debris may cause the radiation pain also[18]. Therefore, nerve root adhesion may occur after minimally invasive lumbar surgery, and revision surgery is effective. During revision surgery, delicate and gentle operation were performed and the time of operating electrotome around the nerve root were restricted, in order to reduce postoperative local inflammatory reaction and the possibility of re-adhesion. Some surgeons placed gelatin sponges containing hormones after nerve root decompression to reduce postoperative nerve root edema and pain symptoms[19, 20]. Drugs or biofilms were also adopted to prevent nerve root adhesion[21-24].However, the efficacy of these methods in preventing dural adhesion was controversial[25].

There were some limitations in this study. As a retrospective study with a small number of cases, there may have been bias in the selection of research subjects. And there was not a blank control group in this study. Furthermore, the first minimally invasive surgery was performed by a different surgical team, and surgical techniques of the first minimally invasive surgery were uncertain.

In conclusion, despite various minimally invasive surgeries for lumbar degenerative diseases, some cases were ineffective. For cases with residual disc herniation or lumbar spinal stenosis, revision surgery should be chosen. For cases without imaging abnormalities, nerve root adhesion is likely to be present, and revision surgery can be performed after a definite diagnosis of nerve root block. During the surgery, adequate nerve root release is the key to the success. Moreover, delicate and gentle operation is needed to avoid excessive local injury and re-adhesion.

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