

# Early effect of lumbar dynamic fixation for treatment of lumbar disc herniation

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## Abstract

**BACKGROUND:** Currently, one of common methods is discectomy, nerve root decompression and fusion rigid fixation from the midline approach for disc herniation which is inefficient by conservative treatments. Thus, it is causing degeneration and limiting lumbar physiological activity of adjacent segments. The treatment of non-fusion lumbar disc herniation with the traditional posterior midline incision approach has some disadvantages such as big incision, wide peeling, and back muscle denervation.

**OBJECTIVE:** To observe therapeutic effects of dynamic stabilization system through Wiltse approach on lumbar disc herniation, and to compare the outcomes with traditional posterior approach.

**METHODS:** A total of 46 patients, who had undergone discectomy and internal fixation using dynamic stabilization systems for lumbar disc herniation at the Renmin Hospital of Wuhan University from January 2011 to January 2013, were enrolled in this study. The operation was performed through the traditional posterior approach in 25 patients and Wiltse approach in 21 patients.

**RESULTS AND CONCLUSION:** All 46 patients were followed up for 7 to 31 months (averagely, 13.8±2.4 months). The length of incision, intraoperative blood loss, and postoperative drainage amount were less in the Wiltse approach group than in the traditional posterior approach group ( $P < 0.05$ ). No significant difference in visual analog scale scores and operative time was detected between the two groups at 1 week and 6 months after fixation ( $P > 0.05$ ). Radiographs revealed that the position of implants was good in all patients, no loosening or breakage. These data verified that the early effect of dynamic stabilization system through Wiltse approach for lumbar disc herniation is similar to that of traditional posterior approach.

**Subject headings:** intervertebral disk displacement; discectomy; internal fixators; intervertebral disk degeneration

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## INTRODUCTION

Currently, the rear decompression and fusion are still the conventional methods for treatment of lumbar disc herniation<sup>[1-2]</sup>. However, it can cause the rear lower back pain after surgery for soft tissue injuries of the spine, and increasing adjacent segments compensatory activities due to the fixed segment after fixation and fusion<sup>[3-4]</sup>, which can lead to the long-term degeneration of adjacent segments<sup>[5-6]</sup>. To solve this problem, lumbar dynamic stabilization systems are designed and used in clinic<sup>[7-8]</sup>, it can not only keep the normal physiological activity of the fixed lumbar spine, so as to achieve both fixation without causing adjacent segment degeneration in theory<sup>[9-10]</sup>. However, it can cause extensive soft tissue damage *via* the traditional approach behind the lumbar part<sup>[11-12]</sup>, while the implanted screw-rod close to the facet joints, to a certain extent, limits the activities of the facet joints, affecting the outcome. In order to reduce damage to the soft tissue, we tried lumbar dynamic fixation through Wiltse

approach (between multifidus and longissimus muscle gap).

## SUBJECTS AND METHODS

### Design

A retrospective study.

### Time and setting

This study was performed in Renmin Hospital of Wuhan University between January 2011 and January 2013.

### Subjects

The patients were due to lumbar disc herniation from January 2011 to January 2013 in our hospital.

Inclusion criteria: eligible patients had single segment disc, and showed low back pain and pain associated with unilateral lower limb reflex leg and dorsum of the foot feeling loss, straight leg raising and strengthening the tests were positive. Preoperative MRI,

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symptoms, signs were consistent with the imaging findings. All of them are ineffective after six weeks of conservative treatments.

Exclusion criteria: disc multi-segment; non-lumbar prominent; merger spondylolisthesis lumbar disc; non-dynamic non-fusion fixed; non Wiltse approach.

Of 46 patients, the traditional behind approach was used in 25 cases, and Wiltse approach in 21 cases; 26 males, 20 females, aged 24 to 60 years, averagely 45.5 years. Eligible patients were single segment disc, L<sub>4-5</sub> in 26 cases, L<sub>5</sub>-S<sub>1</sub> in 20 cases, 28 cases of central and square sides; 18 cases showed low back pain and pain associated with unilateral lower limb reflex leg and dorsum of the foot feeling loss, straight leg raising and strengthening the tests were positive. Preoperative MRI, symptoms, and signs were consistent with the imaging findings. All patients underwent dynamic fixed single segment; the choice of screw-rod system includes Cosmic System (Ulrich Medical, Germany) 10 cases, Dynesys system (Zimmer, Inc., USA) 10 cases, and Devine-Elrod Systems (Orthmed company, China) 26 cases.

## Methods

### Operation method

After the success of anesthesia, the patient was prone on the operating table. C-arm X-ray positioned surgical segment. All of the incision was after founder of spine, the traditional approach was 7–8 cm, and Wiltse approach was 4–5 cm. Founder of the traditional approach was used to peel Erector bilateral facet, not repeat them here. Wiltse approach after the incision, the skin after skin incision, to the separation between the subcutaneous muscle membranes between two layers may be needed for further free. Spinous process to open a cross refers to about 1.5–2.0 cm at the incision fascia, blunt dissection and multifidus dorsi muscle gap to the target facet, facet coagulation exposed outer edge of the root and vice sudden. We selected the external facet the lower edge of the root or roots and vice facet junction point as pedicle screws protruding needle point, protecting the facet joint capsule; the needle direction was parallel to the sagittal plane and the end plate, the coronal plane with the longitudinal axis of the spinous process 30°–45° angle pedicle screws, C-arm fluoroscopy set nail correct, according to the patient's condition needs to be inside the multifidus muscle stripping, exposing the lamina and facet, the "unilateral fenestration or fenestration less pressure and then with discectomy" if necessary, "the nerve root canal augmentation" mounting pole, complete hemostasis, the drainage tube placed layered suture the wound (**Figure 1**).

### Postoperative management

Using of a dehydrating agent, dexamethasone (5 mg, ivgtt, bid) and antibiotics within 3 days postoperatively. The drainage tube was pulled out after 48 hours. Start straight leg raising training and back muscle function during exercise in patients with no significant back pain after

postoperative 2 days. They got out of bed with the aid of a walker 1–2 weeks later.

### Observational index

We compared the two approaches surgical incision length, operative time, blood loss, postoperative drainage and complications. Pain visual analog scale was assessed before and after evaluation of surgical patients with low back pain. Periodic review of postoperative X-ray evaluation of the situation of internal fixation was conducted.

### Main outcome measures

There were incision length (cm), operation time (minute), intraoperative blood loss (mL), postoperative drainage (mL), visual analog scale score of low back pain at different time points, such as preoperative, after 1 week, and six months.

### Statistical analysis

All data were analyzed with SPSS 19.0 (SPSS Inc., USA) statistical software, and were expressed as mean  $\pm$  standard deviation, using the *t* test to compare indicators. A value of  $P < 0.05$  was considered statistically significant.

## RESULTS

### Quantitative analysis of subjects

All participants were included in the final analysis. The groups of 46 patients were followed up for 7 to 31 months, mean  $13.8 \pm 2.4$  months.

### Effects of lumbar dynamic fixation through Wiltse approach

Two groups of patients at 1 week after low back pain were significantly reduced, and the difference between the visual analog scale score before surgery was statistically significant ( $P=0.000$ ). Compared to the length of the incision, the differences in intraoperative blood loss and postoperative drainage were statistically significant between two groups of patients, while no significant difference in the operation of low back pain visual analog scale score and time after 1 week and after 6 months was found ( $P > 0.05$ ; **Table 1**).

### Adverse reactions of lumbar dynamic fixation through Wiltse approach

Four patients would suffer from effusion postoperative and delayed healing after puncture with bandaged in traditional approach group, and the remaining wounds healed. In Wiltse approach group, two patients had partial necrosis of the skin incision edge, after dressing healed. At the final follow-up, X-ray showed a good fixation position and no loose or broken in all patients.

### Typical case of lumbar dynamic fixation through Wiltse approach

There was a typical case, female, aged 52, L<sub>4/5</sub> disc herniation with right lower extremity pain and numbness for three months (**Figure 2**).

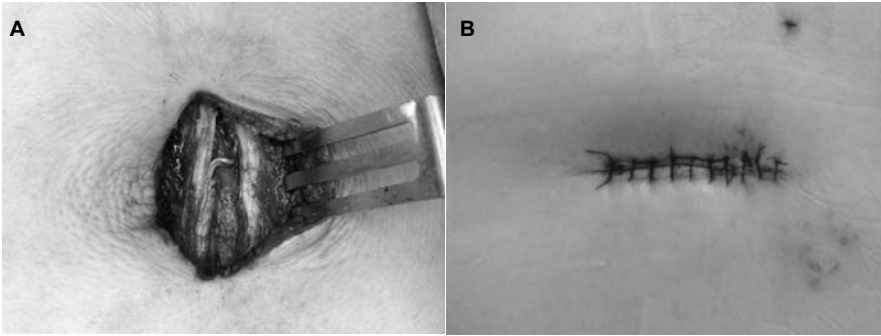


Figure 1 Lumbar dynamic fixation through Wiltse approach  
 Note: A: Incision of lumbar dynamic fixation through Wiltse approach; B: suture after fixation.

Table 1 Comparison of observations between traditional approach and Wiltse approach (x̄±s)

Item	Traditional approach group	Wiltse approach group	t	P
n	25	21		
Incision length (cm)	7.5±0.7	4.5±0.5	16.421 4	0.000 0
Operation time (minute)	150.8±52.7	126.3±43.9	1.692 7	0.097 6
Intraoperative blood loss (mL)	420.4±109.7	227.1±96.4	6.287 2	0.000 0
Postoperative drainage (mL)	316.8±56.3	112.5±47.6	13.140 4	0.000 0
Visual analog scale score (low back pain)				
Preoperative	7.5±1.3	7.6±1.4	0.250 9	0.803 0
After 1 week	2.5±1.2	2.3±1.0	0.606 8	0.547 1
After 6 months	1.2±0.4	1.1±0.3	0.943 6	0.350 5

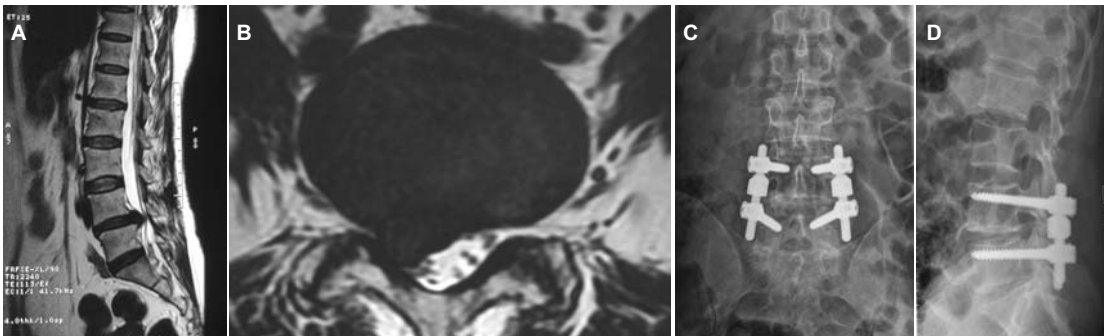


Figure 2 A typical case of lumbar dynamic fixation through Wiltse approach  
 Note: A female 52-year-old patient was diagnosed L<sub>4/5</sub> disc herniation (A, B). The recovery of patient's function was good at 6 months after fixation. C, D: Anteroposterior and lateral radiographs of patients, respectively.

**DISCUSSION**

Lumbar disc herniation is a common clinical disease, and it often needs surgery failed conservative treatment<sup>[13-18]</sup>. The goal of surgery included disc removal, reconstruction of spinal or nerve root canal decompression and lumbar stability<sup>[19-24]</sup>. Lumbar fusion surgery is the gold standard since Hibbs and Albee against degeneration caused by lower back pain and spine instability in 1911. After the posterior discectomy and fusion plus also become a routine method for lumbar disc herniation<sup>[25-28]</sup>. However, due to the fixed segment fusion lesions cause the disappearance of the activities of the segment, and adjacent segments will appear compensatory increase in activity and intradiscal pressure, it will occur degeneration and corresponding symptoms with the elapsing of time, and to patients with new pain<sup>[29]</sup>. If not fixed after discectomy fusion, it will cause instable and degenerative lumbar acceleration<sup>[30-32]</sup>. Thus, how can we maximize the retention of physical activity

segmental lesions become the direction of research.

Fixed non-fusion, also known as fixed or dynamic fixation of soft, rigidly fixed to the fixed mode differs, which allows the fixed segment in the normal range of motion<sup>[33-37]</sup>. At present, the fixed devices for dynamic system had multiple types, such as Graf ligament system<sup>[38]</sup>, Dynesys system<sup>[39-41]</sup>, Cosmic system<sup>[42-44]</sup>, and Devine-Elrod system. Schmoelz's<sup>[45]</sup> study showed that the human spine specimens with Dynesys system while maintaining the stability of the spine can retain its normal range of motion, and exhibit good dynamic fixation. Stoll *et al*<sup>[46]</sup> conducted a multicenter prospective clinical study and showed that the use of the treatment of lumbar disease Dynesys system was safe and satisfactory. Erbulut *et al*<sup>[47]</sup> showed that the use of an interim efficacy Dynesys system for the treatment of lumbar disc herniation satisfaction from the rear into the road. In this study, two groups of patients before surgery

compared with preoperative symptoms and signs of significant improvement in the last follow-up position when the fixture was good, no loose and broken, this was consistent with the results of the research scholars to prove that the use of dynamic stabilization system fixed lesions again lumbar effectiveness and practicality.

Founder of the approach is the classical type of posterior decompression and fixation approach, with a clear anatomical structure and a short learning curve<sup>[48]</sup>. However, the following disadvantages present: (1) posterior lumbar is mainly composed by paraspinal muscles and multifidus dorsi muscle, and supported by the spinal segmental innervation; it has an important role in maintaining the stability of the spine. The traditional Founder approach requires extensive dissection of paraspinal muscles, which can cause iatrogenic postoperative adhesions and scar back pain<sup>[49-50]</sup>; (2) Erector after peeling strength required to achieve joint distraction on both sides of the conflict, long powerful distraction can cause partial muscle ischemia, necrosis and denervation<sup>[51]</sup>, is not conducive to the recovery of postoperative back muscle and can lead to increased postoperative drainage and wound blood flow; (3) dynamic fixed goal is to retain as much as possible facet of physical activity, and extensive soft tissue stripping and integration will result in ossification facet; (4) dynamic fixed screw-rod system should not interfere with normal activities facet, therefore, need to be placed in the lateral facet nail, and through this approach it is more difficult to complete the operation.

Wiltse *et al*<sup>[52]</sup> proposed the multifidus dorsi muscle and into the road in 1968, this road through the muscle into the gap operation is relatively simple, without stripping the muscles, and the muscle is not formed between postoperative scar tissue, and can also direct articular surface and transverse processes. In 2013, Buttermann *et al*<sup>[53]</sup> reported the paraspinal muscles approach for lumbar spondylolisthesis, lumbar disc herniation and lumbar spinal stenosis. Given the approach of the above characteristics, we try to approach the dynamic lumbar fixed, in order to overcome the lack of road into the Founder. The results of this study show that the approach of the surgical incision in intraoperative blood loss, and postoperative drainage volume is better than the Founder of the approach. Without approach-related complications except that two patients had partial necrosis of the skin incision edges. In addition, the incision also has the following advantages: (1) small incision, single-segment fixation may be about 4 cm incision after subcutaneous free in the incision, the incision can be made according to operational needs, down, left, right movement, the group showed that the average length of 4.5 cm incision; (2) After blunt dissection of muscle gap can be directly oriented lateral facet, reduce blood loss, can be directly exposed set screws, without a strong distraction, to protect the integrity of muscle and blood supply, there conducive to early rehabilitation of low back muscles, this group of postoperative bleeding less than traditional group; (3) clearance from pedicle screws can be increased according to the requirements set nail abduction angle (45° left and

right), both to avoid stick on nail facet of oppression, but also to choose longer nails, screws holding force increases, more in line with the dynamic characteristics of the fixed biomechanics; (4) this approach can be done through unilateral or bilateral spinal windows, fenestration, discectomy, nerve root decompression operation, with good usability.

In conclusion, Wilste approach has some advantages such as minimal invasion, simple and practical method, and quick recovery. However, the limitations of this study include small sample size, and short following-up, but long-term efficacy remains to be seen.

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## 腰椎动态植入物内固定系统治疗腰椎间盘突出症的早期疗效

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### 文章亮点:

1 实验特点在于通过对比 Wiltse 入路和传统后方入路行腰椎间盘摘除+腰椎动态稳定植入物系统固定治疗腰椎间盘突出, 证实 Wiltse 入路腰椎动态内固定植入物系统治疗腰椎间盘突出的早期疗效与传统后方入路接近, 但术后功能恢复效果更好。

2 文章创新之处在于将 Wiltse 入路结合动态非融合联合应用治疗腰椎间盘突出症。不足之处在于尽管选取病例尽量为单节段腰椎间盘突出症的患者, 但因存在着个体化的差异, 无法达到基线水平完全一致。因此, 证实文中的观点需要大样本、多中心、设计更合理的方案。

### 关键词:

植入物; 脊柱植入物; 动态稳定系统; 腰椎间盘突出症; 刚性稳定系统; 手术入路; 传统入路; Wiltse 入路; 椎间盘切除; 早期疗效

### 主题词:

椎间盘移位; 椎间盘切除术; 内固定器; 椎间盘退化

### 摘要

背景: 目前, 对保守治疗无效的椎间盘突出

症常用方法是经后正中入路髓核摘除、神经根管减压和刚性融合内固定, 由此引起相邻节段的退变和腰椎生理活动受限是临床所面对的问题; 而非融合固定的传统后正中入路则由于存在切口大、剥离广、腰背肌的失神经支配等缺点。

目的: 观察经 Wiltse 入路腰椎动态稳定植入物内固定系统治疗腰椎间盘突出症的疗效, 并与传统后方入路的疗效进行比较。

方法: 纳入因腰椎间盘突出症于 2011 年 1 月到 2013 年 1 月分别在武汉大学人民医院行腰椎间盘摘除+腰椎动态稳定系统固定的患者 46 例, 其中经传统后方入路 25 例, Wiltse 入路 21 例。

结果与结论: 46 例患者均获得随访, 随访时间 7-31 个月, 平均(13.8±2.4)个月。

Wiltse 入路组患者切口长度、内固定中失血和内固定后引流均低于传统后方入路组( $P < 0.05$ ); 但 2 组患者内固定后 1 周和 6 个月目测类比评分与手术时间比较差异无显著性意义( $P > 0.05$ )。X 射线显示所有患者内固定物位置良好, 无松动或断裂。提示 Wiltse 入路腰椎动态植入物内固定系统治疗腰椎间盘突出的早期疗效与传统后方入路接近。

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利益冲突: 文章及内容不涉及相关利益冲突。

伦理要求: 参与试验的患病个体及其家属自愿参加, 在充分了解本治疗方案的前提下签署“知情同意书”; 干预及治疗方案获医院伦理委员会批准。临床试验参研人员具有主任医师职称, 有从事脊柱外科多年、具有从事脊柱外科所要求的资质。

学术术语: 腰椎间盘突出症-主要是因为腰椎间盘各部分(髓核、纤维环及软骨板), 尤其是髓核, 有不同程度的退行性改变后, 在外力因素的作用下, 椎间盘的纤维环破裂, 髓核组织从破裂之处突出(或脱出)于后方或椎管内, 导致相邻脊神经根遭受刺激或压迫, 从而产生腰部疼痛, 一侧下肢或双下肢麻木、疼痛等一系列临床症状。

作者声明: 文章为原创作品, 无抄袭剽窃, 无泄密及署名和专利争议, 内容及数据真实, 文责自负。

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