

## Original Article

# Observation of dynesys dynamic fixation for lumbar disc herniation: a two-year clinical follow-up

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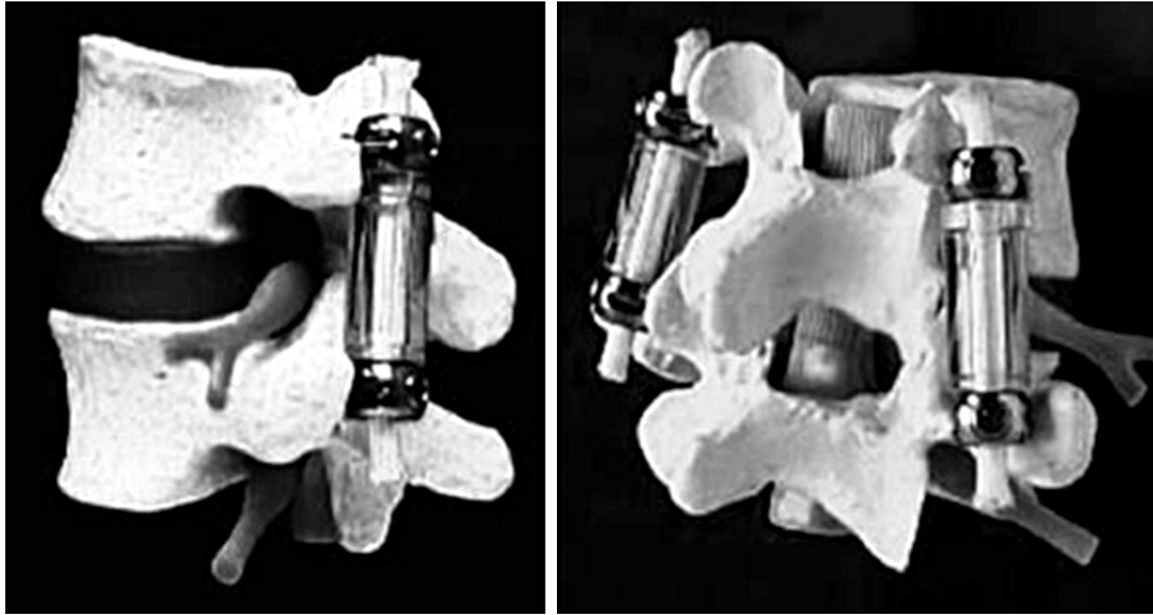
**Abstract:** Objective: To investigate the clinical effect of Dynesys dynamic fixation for double-segmental lumbar disc herniation and the degeneration of adjacent segment. Methods: 52 patients, who received Dynesys dynamic fixation for double-segmental lumbar disc herniation in our hospital from Mar 2009 to Mar 2012, were enrolled as research subjects; among them, 34 were male and 18 were female with an average age of  $(44.3 \pm 3.6)$  years old (19-67 years old). Oswestry dysfunction index (ODI) and visual analogue scale (VAS) was evaluated before surgery and during the outpatient follow-up in two years after surgery. X-ray and MRI on lumbar spine were done to evaluate the intervertebral height of adjacent segments and signal intensity of nucleus pulposus, respectively; degeneration was determined as 10% decrease in intervertebral height and one level degrade in signal intensity of nucleus pulposus. Logistics regression analysis was used to explore the risk factors of adjacent segment degeneration (ASD). Results: Two-year follow-up showed that all patients had satisfactory recovery in nerve function and alleviation in pain; ODI was significantly lower than that before operation ( $21.4 \pm 3.0$  VS.  $66.3 \pm 7.9$ ,  $p=0.001$ ), and VAS decreased significantly by comparing with the pre-operation ( $2.0 \pm 0.1$  VS.  $6.4 \pm 0.5$ ,  $p < 0.001$ ). There were no significant changes in the intervertebral height nor ROM of adjacent segments ( $P > 0.05$ ). 9 patients (17.3%) had adjacent segment degeneration showed by imaging; by regression analysis, we found that BMI  $> 30 \text{ kg/m}^2$ , age  $> 50$  years old were the risk factors for adjacent segment degeneration. Conclusion: Dynesys dynamic fixation in treating double-segmental lumbar disc herniation could achieve satisfactory effects in nerve function recovery and pain alleviation, obesity and old age are the risk factors for adjacent segment degeneration.

**Keywords:** double-segmental lumbar disc herniation, Dynesys dynamic fixation, adjacent segment degeneration

## Introduction

Lumbar disc herniation is a common disease in the department of orthopedic. Lumbar interbody fusion is the most common treatment, but it can easily lead to limited activity of the segment and increase the stress as well as the risk for adjacent segment degeneration. To solve above problems, in recent years, the concept of dynamic fixation was promoted, which can not only keep the normal physiological curvature of the fixed segment but also effectively maintain the stability of the spine. Dynesys dynamic fixation is currently the most widely used posterior lumbar non-fusion technology; biomechanical studies have shown that compared to rigid internal fixation, Dynesys dynamic fixation is able to retain part of the intervertebral motion while maintaining spinal stability and reducing

the pressure inside the intervertebral disc; comparing with rigid internal fixation. Dynesys dynamic fixation has less impact on adjacent segments and more advantages in keeping spine flexion and extension activities [1-4]. Nowadays, the Dynesys dynamic fixation system is mainly used in single-segmental lumbar disc herniation, lumbar instability, lumbar spinal stenosis and lumbar spondylolisthesis [5-7]; however, its clinical application in double-segmental lumbar disc herniation has been rarely reported. The purpose of this study is to investigate the effect of Dynesys dynamic fixation in treating double-segmental lumbar disc herniation and the degeneration condition of adjacent segment, the risk factors of adjacent segment degeneration was statistically analyzed to provide reference for adjusting the indications of Dynesys dynamic fixation.



**Figure 1.** The working principle of Dynesys system in the spine model.

**Table 1.** ODI and VAS of patients before and after treatment ( $\bar{x} \pm s$ )

Index	Preoperative	Postoperative	P
ODI	66.3 $\pm$ 7.9	21.4 $\pm$ 3.0	0.001
VAS on lumbocrural pain	6.4 $\pm$ 0.5	2.0 $\pm$ 0.1	< 0.001

## Material and methods

### General information

52 cases of patients, who underwent Dynesys dynamic fixation for double-segmental lumbar disc herniation in orthopedics of our hospital from January 2009 to February 2013, were selected in this study; the clinical data were all complete for these 52 patients; among them, there were 34 male and 18 female with an average age of 44.3 $\pm$ 3.6 years old (19-67 years old); the disease lasted from 6 months to 14 years. Segmental lesions: 5 cases of L2-3, 4 cases of L3-4, 36 cases of L4-5 and 7 cases of L5-S1; all selected objects suffered nerve compression that caused by different degrees of lumbar disc herniation, such as waist pain, lower limb pain from one or both sides, numbness, claudication. After 3 months of systematic conservative treatment, the symptoms were not relieved or even aggravated. Lumbar spine X-ray and lumbar vertebra MRI were done before surgery. X-ray suggested narrow intervertebral space and the vertebral hyperplasia,

while MRI showed the lumbar disc herniation with different degrees of signal change in nucleus pulposus and protrusion of adjacent segment.

Inclusion criteria: 1. Double-segmental lumbar disc herniation confirmed by MRI; 2. No history of trauma, scoliosis, infection or surgery; 3. Complete preoperative imaging data (Lumbar spine X-ray and lumbar vertebra MRI). Exclusion criteria: 1. Patients with serious cardio-cerebrovascular diseases; 2. Patients with severe osteoporosis; 3. Patients with incomplete imaging data.

### Operation method

After general anesthesia, the patients were in the prone position. A posterior midline skin incision was created; the muscle tissues were isolated toward external along the spinous process to expose vertebral lamina, articular process and partial transverse process. Positioning nails were inserted at the upper 1/3 of the intersection of transverse process and external of superior articular process, and then titanium alloy screws were inserted after confirming the position of nails by imaging means. Again after confirming the screw position, polyester fiber rope and polycarbonate polyurethane elastic spacer were inserted according to the operation procedures of Dynesys system. After the operation, open-win-



**Figure 2.** Image data of Dynesys dynamic fixation before and after operation. A. Postoperative X-ray film on anterior position; B. Postoperative X-ray film on lateral position; C. Preoperative MRI slice; D. Postoperative MRI slice; Note: after treatment, the X-ray showed the screw position was good without loosening or displacement, and there was no adjacent segment degeneration. MRI showed no significant changes in L3-4 intervertebral disc of the adjacent segment after treatment.

dow nucleus pulposus resection was performed. Rinse incision, place flow tube, and suture layer by layer. After the operation, the patients were treated with conventional anti infection and other symptomatic treatments. Remove the drainage tube 1-2 days after surgery; remove the waist circumference 1 month after surgery; regular X-ray examination should be carried on. See **Figure 1**.

#### Follow up and observation

Oswestry disability index (ODI) was used to assess the quality of life and functional recovery status of patients at pre-operation and outpatient follow-up in two years; visual analogue scale (VAS) was used to evaluate the pain alleviation in waist and lower extremities of patients: 0 point for painless, 10 points for unbearable severe pain; X-ray examination was used to measure the intervertebral height of adjacent segments; and MRI was used to evaluate signal intensity of nucleus pulposus, and degeneration was determined as 10% decrease in intervertebral height and one level degrade in signal intensity of nucleus pulposus. Range of motion (ROM): the Cobb's angles (anterior flexion position and posterior extension position) of operated segment and adjacent segments were calculated by referring lumbar flexion-extension radiograph. Segment motion = Cobb's angle of extension-Cobb's angle of flexion.

#### Statistical analysis

SPSS13.0 was used for data entering and analyses; univariate analysis or independent sample t test was used for the comparison between the data of ODI and VAS collected from pre- and post-operation; binary logistic regression analysis was used to evaluate the risk factors of adjacent segment degeneration; the difference has statistical significance when  $P < 0.05$ .

#### Results

##### *Evaluation on the clinical effect of Dynesys dynamic fixation for double-segmental lumbar disc herniation in two years after surgery*

The post-operative ODI and VAS of patients, compared with preoperative data, decreased significantly in two years after surgery, and the differences were statistically significant (ODI:  $t=11.38$ ,  $p=0.001$ ; VAS:  $t=9.27$ ,  $P < 0.001$ ). See **Table 1**. Image of typical cases is shown in **Figure 2**.

##### *Imaging evaluation*

Comparing with preoperative data, there was no significant change in postoperative intervertebral height (L3-4, L5-S1 and adjacent upper and lower segment) or ROM ( $P > 0.05$ ). See **Table 2**.

**Table 2.** Intervertebral height and ROM of patients before and after treatment

Project	L3-4		L5-S1	
	Preoperative	Postoperative	Preoperative	Postoperative
Intervertebral height (mm)	11.34±1.32	10.33±2.08	11.27±2.46	11.46±2.01
ROM (°)	7.93±1.57	8.35±1.25	7.44±1.04	7.74±2.08

**Table 3.** Multivariate regression analysis of the occurrence of adjacent segment degeneration

Parameter	Beta value	SE	Wald value	OR value	95% CI
Age	0.31	0.029	4.26	3.25	2.146-11.437
Gender	0.37	0.063	5.43	0.05	0.676-0.924
BMI	0.25	0.024	4.17	0.32	0.261-0.653
Intervertebral height	0.85	0.087	8.74	0.19	0.075-0.080
MRI signal strength	0.14	0.022	3.21	0.07	0.121-0.367

*Occurrence of adjacent segment degeneration in two years after Dynesys dynamic fixation for double-segmental lumbar disc herniation*

9 cases (17.3%) of patients had ASD according to evaluation standards; the ASD was used as the dependent variable, age, sex, BMI, preoperative intervertebral height and preoperative MRI signal intensity were used as risk factors for binary logistic regression analysis; the results showed that BMI > 30 kg/m<sup>2</sup>, age > 50 years old were the risk factors of adjacent segment degeneration (see **Table 3**).

*Adverse events*

There were no serious intra-operative complications such as nerve root injury, massive hemorrhage and death etc. One patient had postoperative wound infection, which was healed after debridement and suture; during the 2-year postoperative follow-up, no patients had fixation loosening, fracture, dislocation or other serious complications. No adverse events such as allergy or rejection to Dynesys system was found during the follow-up.

**Discussion**

Lumbar degeneration is one of the most common diseases in spine surgery. Degeneration induced lumbar disc herniation, lumbar spinal stenosis, isthmus spondylolisthesis and lateral bending etc. may further cause low back pain or radicular pain. Spinal fusion surgery is the traditional surgical approach for lumbar degen-

eration, and it is reported to have a significant advantage over non-surgical therapy. However, the increase in fusion rate didn't always bring improvement of clinical efficacy; there still are many patients who didn't get significant relief in low back pain; current researches show that ASD caused by lumbar fusion surgery has great impact on its clinical effect [8, 9], and related Biomechanical studies have demonstrated that there

was a significant pressure increase in adjacent segment disc and articular process after infusion surgery [10]. To solve this problem, some scholars put forward the concept of "dynamic fixation" or "elastic fixation" to retain certain activity of segments on the basis of stabilizing the spine, thereby reducing stress shielding and ASD. Among them, Dynesys system are more used; some studies have shown [11], with Dynesys dynamic fixation, the motion of fixed segment in flexion and extension, lateral bending and rotation position could be reduced to 26%, 33%, 76% of the normal level, respectively. Finite element analysis model was used to analyze the mechanical mechanism of the dynamically fixed lumbar; the result showed Dynesys dynamic fixation could provide sufficient stability to operated segment and reduce the pressure on disc and facet joints, but it increased the adjacent segments motion, annulus pressure and facet joint loads [12].

Some scholars believe the indications for Dynesys dynamic fixation system are: mild degenerative spondylolisthesis, degenerative disc disease with spinal instability, degenerative spinal stenosis and intervertebral disc herniation with spinal flexion instability [13]. Combined with the views of other scholars, we have concluded that the indications for Dynesys system could be: (1) spinal stenosis with moderate spinal instability, (2) lumbar spondylolisthesis at Level I, (3) adjacent vertebrae degeneration after fusion, (4) recurrent disc herniation or herniated disc degeneration, (5) disc degeneration



induced low back pain. Its contraindications include: (1) isthmus or degenerative spondylolisthesis at level I or II; (2) degenerative scoliosis > 100°; (3) cervical or thoracic disease; (4) one-sided fixation; (5) fused segments; (6) local bone tumor; (7) obvious osteoporosis; (8) vertebral fracture, dislocation and infection; (9) pedicle screw insertion difficulties caused by various reasons.

For single-segmental lumbar disc herniation, dynamic fixation system can avoid or mitigate the occurrence of ASD, but for double-segmental lumbar disc herniation, whether dynamic fixation could reduce the occurrence of ASD is rarely reported. The results of this study showed 9 cases (17.3%) of patients had ASD according to the degeneration standard. Beastall found that the lumbar segment, which was operated with Dynesys system, retained partial motion, however, the adjacent segment had no significant motion improvement, the anterior intervertebral height decreased at certain degree, but the posterior intervertebral height was not significantly increased. Studies have shown that [14] VAS and ODI were significantly improved after Dynesys dynamic stabilization surgery, the motion of operational segment was partially preserved, and there was no significant influence on the activity of adjacent segment, which further speculated that Dynesys system can be used as an alternative approach for lumbar degenerative disease to prevent ASD. Some scholars also suggested that [15, 16] intervertebral disc degeneration can be prevented and partially repaired by dynamic stabilization, and the surgery had more obvious effect on severe degenerative intervertebral disc. 2 years after Dynesys fixation, patients re-examined with MRI and the Woodend score on the degeneration of fixed segment was significantly increased, comparing with adjacent segment; the height of the frontier edge of intervertebral disc was decreased by an average of 2 mm. Although Dynesys system played a role of stabilization, intervertebral disc degeneration was still going on, no matter in the fixed segment or in the adjacent segments; this is the natural progression of the lumbar spine degeneration, rather than the results of internal fixation. In a word, Dynesys didn't eliminate the risks of degeneration in adjacent segments [17].

Some scholars have studied the influence of BMI on the postoperative effect of patients with lumbar disc herniation, which showed that high BMI was an unfavorable factor for lumbar disc surgery, especially for female patients; losing weight may be one of the important contents of postoperative rehabilitation [18]. At the same time, some researches found that there were significant differences in the degree of intervertebral disc degeneration between obese female patients and normal weight patients, which suggested the high BMI was related to the degree of intervertebral disc degeneration in female patients with lumbar disc herniation [19, 20]. In this study, by using Binary Logistics Regression Analysis, we found that BMI > 30 kg/m<sup>2</sup> and age > 50 years were two risk factors for adjacent segment degeneration. It might be associated with the following factors: physical condition declines in elderly patients and their tissue repair ability is poor, as a result, elderly patients have limited activities after operation, causing accelerated degeneration of adjacent intervertebral disc. In addition, paraspinal muscles play an important role in spine movement, however, the degeneration of paraspinal muscles in elderly patients gradually aggravates as age getting older, and functional limitation of paraspinal muscles would lead to a significant decrease in the motion function of spine. The local stress change in spine will have influence on the intervertebral disc of adjacent segments, and finally cause adjacent segment degeneration.

In summary, 2 years after the Dyneys dynamic fixation for double-segmental lumbar disc herniation, the patients satisfied with the improvement of neurological function and pain relief. And the incidence of ASD after Dynesys dynamic fixation was comparable to that of the patients with single-segmental lumbar disc herniation. Obesity and old age are the risk factors for the degeneration of adjacent segment.

### Disclosure of conflict of interest

None.

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