Single cage plus unilateral pedicle screw placement for treating lumbar degenerative instability in 51 cases★

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Abstract

BACKGROUND: Most of the patients suffered from degenerative lumbar instability are treated by exposure both sides and bilateral pedicle screw fixation, which bring highly operative risk, large blood loss and great medical expenditure to patients.

OBJECTIVE: To explore the clinical efficacy of single cage plus unilateral pedicle screw placement for treating lumbar degenerative instability.

METHODS: Totally 51 cases with lumbar degenerative instability underwent single cage plus unilateral pedicle screw placement were selected, including 32 males and 19 females, aged ranging from 41 to 72 years. 47 cases had single segment involved and 4 cases had two segments involved. All cases experienced unilateral laminectomy and transforamenal lumbar interbody fusion. The therapeutic effect was assessed by Japanese Orthopaedic Association (JOA) score system.

RESULTS AND CONCLUSION: The blood loss was 90–430 mL. The surgical time was 100 minutes (85–120 minutes) for single segment and 150 minutes (120–170 minutes) for double segments. The patients were allowed to early ambulation at 2–3 days after operation. Two cases did not get improvement on back-leg pain, but there was no abnormality from CT and MRI recheck, one case felt pain relieved after anti-symptom treatment for 3 months while the other did not relieve. The average JOA scores at pre-operation and 1 year follow-up was 11 (7–13 scores) and 25 (18–27 scores), respectively. The total improvement rate of JOA was larger than 50%. 44 cases were evaluated as fusion and 7 cases as possible fusion. The average fusion time was 5.4 months (4.3–7.1 months). Postoperative X-ray showed no evidence of pedicle screw loosening, broken, or cage displacement. Single cage plus unilateral pedicle screw placement is characterized by simple operation, small blood loss, short operation and few interference to spine, which is a better method for treating lumbar degenerative instability.

INTRODUCTION

With the progress of aging population, degenerative lumbar instability has shown an increasing tendency. Boucher[1] used pedicle screw in lumbar fusion in 1959. With the development of spine microsurgery, on the ground of tradition surgery method, Kabins *et al*[2] first reported the clinical application of unilateral pedicle screw for inter-body fusion in 1992. Suk *et al*[3] made a prospective research on unilateral and bilateral pedicle screw instrumentation and fusion, and found that there were no differences between unilateral and bilateral pedicle screws replacement on fusion rate and complication. Zhao *et al*[4] proved that stability of unilateral cage was better than bilateral by experiments, Tencer *et al*[5] thought that cage placement was not increase the stability of vertebral, because of severe damage in lumbar structure caused by bilateral cages placement, its biomechanical stiffness after operation was worse than unilateral cage placement. Molinari *et al*[6] study showed that there was no significant difference in fusion rate and clinical effect between unilateral and bilateral cage. Chinag *et al*[7] study between unilateral and bilateral cage through finite element method testified that unilateral cage could generate same stability as bilateral cages. Fan *et al*[8] three-dimensional finite element analysis also showed there was no significant difference in vertical biomechanics between unilateral and bilateral cage. A total of 51 cases with lumbar degenerative instability patients underwent single cage plus unilateral pedicle screw at the First Affiliated Hospital of Dalian Medical University between June 2006 and February 2008 and got a good clinical efficacy were reported here.

SUBJECTS AND METHODS

Design

A retrospective study.

Time and setting

The experiment was performed at the First Affiliated Hospital of Dalian Medical University between June 2006 and February 2008.

Subjects

Totally 51 cases with lumbar degenerative instability underwent single cage plus unilateral pedicle screw placement were selected, including 19 females and 32 males, aged ranging from 41 to 72 years old (average 59.1 years old), course of disease ranging from 3 months to 17 years. In order to identify the location and degree of disc hernaition and spinal stenosis, all patients committed CT and MRI examination and the lumbar stability was assessed through dynamic X-ray examination. All patients complained of low back pain combined with radiological pain in lower limbs without spondylolysis and Ⅱ degree or above lumbar spondylolisthesis. 24 had disc protrusion plus intervertebral instability and 27 had lumbar spinal stenosis plus degenerative instability. 47 cases had single segments involved (1 case in $L_{3/4}$, 25 cases in $L_{4/5}$, 21 cases in L_5/S_1), 4 cases had two segments involved (1 case in L3/4 and $L_{4/5}$, 3 cases in $L_{4/5}$ and L_5/S_1). All patients were excluded spondylolisthesis, overweight, over three disease segments, severe osteoporosis and Ⅱ degree or above lumbar spondylolisthesis. The informed consent was obtained from each patient

before operation. The cage (peek cage) and pedicle screw (titanium alloy) were provided by Johnson & Johnson (USA).

Methods

All patients took prone position and epidural anesthesia. A 3.0-cm vertical incision was made in the paraspinal paramidline, the affected vertebral canal and zygopophysis were exposed. A unilateral pedicle screw was inserted after localization with C-arm. The tip part of inferior articular process of upper-vertebra and superior articular process of lower-vertebrae were removed, and the herniated lumbar disc and nerve roots were exposed through inter-vertebral foramen. After that, annulus fibrosus was cut off using a sticker (upper-nerve root in outer margin, dura cyst, and lower never root in inner margin should be protected), then nucleus pulposus was removed using nucleus clamp. When nerve roots were thoroughly decompressed, remained disc and cartilage endplate were resected using different types of drawknives and reverse curets. After bone endplate exposure, autogenous bone extracted during decompression and homogeneity bone were embedded, a single cage was inserted obliquely (upper-nerve root in outer margin, dura cyst, and lower never root in inner margin should be protected once again), the unilateral nail-stick was connected, and a drainage tube was inserted before incision closure.

Treatment after operation

Routine antibiotic was used for 3 days, drainage tube would be detained 24–48 hours (it could be pulled out if the drain volume less than 50 mL per 24 hours). The patients could get off-bed activity under the protection of waistline at 2–3 days after operation and should avoid bend or load overly under protection of waistline for 3 months. Lumbodorsal muscles practice was performed at 3 months after operation.

Evaluation criterion

The therapeutic effect was estimated according to the criterion (29 scores) of back-leg pain enacted by Japanese Orthopaedic Association (JOA) in 1984. The improvement rate = (postoperative score-preoperative score) / (29-preoperative score) × 100%. If the rates range from 75% to 100%, it means excellent, good for 50%–74%, fair for 25%–49%, and poor for 0–24%. Then the superior rate was assessed according to excellent plus good. The fusion rate was judged by Suk[3] judge method: Fusion criterion: bone tranecula passed though fusion segments consecutively and relative motion range between segments was less than 4 mm on dynamic photographs. Possible fusion criterion: bone tranecula was not detected pass though fusion segments consecutively, but relative motion range between segments was less than 4 mm on dynamic photographs. Un-fusion criterion: there was apparent gap between fusion segments and relative motion range between segments was more than 4 mm on dynamic photographs.

RESULTS

The blood loss was 90–430 mL (140 mL for single segment and 240 mL for double segments). The average surgical time was 100 minutes for single segment (85–120 minutes) and 150 minutes for double segments (120–170 minutes). The patients could get off-bed activity at 2 or 3 days after the operation. Two cases did not get improve on back-leg pain, but there was no abnormality from recheck CT and MRI, one case felt pain relieved after anti-symptom treatment for 3 months while the other did not relieve. All patients were followed up for 1–2.5 years. The average JOA scores at pre-operation and 1 year follow-up was 11 (ranging from 7 to 13 scores) and 25 (ranging from 18 to 27 scores) respectively. 38 cases were rated as excellent (75%), 10 cases as good (20%), 2 cases as fair (4%) and 1 case as poor (2%), with the total excellent and good rate of 94%. According to Suk's fusion judge method[3], 44 cases were evaluated as fusion and 7 cases as possible fusion. The average fusion time was 5.4 months (ranging from 4.3 to 7.1 month). Postoperative X-ray showed no evidence of pedicle screw loosening, broken or cage displacement (Figures 1–5)

Figure 1 Dynamic preoperative radiography showed instability in $L_{3/4}$

Figure 2 Preoperative MRI showed disc protrusion in right-side in $L_{3/4}$

Figure 3 Orthotropia postoperative X-ray showed unilateral pedicle screw and single cage in good position

Figure 4 Lateral postoperative X-ray showed unilateral pedicle screw and single cage in good position

Figure 5 X-ray of 1 yr follow-up showed that $L_{3/4}$ had been fused, no evidence of instrument failure

DISCUSSION

In 1990, McAfee *et al*[9] reported that stress-shielding of bone transplantation zone formed by over-rigid fixation of spine could lead to osteoporosis and absorption of grafted bone thus cutting down the fusion rate, therefore proper stress is beneficial to grafted bone to fuse. Harris *et al*[10] biomechanics experiment showed that the strength of unilateral cage can meet the requirements of stability, even somebody[11] thought that it can achieve effect of 360° fusion. Some internal scholar believed cage without additional internal fixation still able to provide load-bearing capacity of the lumbar spine, and it also can get higher intervertebral bone-graft fusion rate[12-14]. But most scholars[15] thought stability of simple cage placement is not enough, and fixation should be added. Self-stability of peek cage is poor supplemented with pedicle screw fixation can enhance the stability[16]. Goel *et al*[16-17] thought that over-rigid fixation will result in tissue around vertebral become sclerosis. Shono *et al*[18] pointed that rigid fixation can lead and accelerate the degeneration of adjacent segments. In 1992, Kabin *et al*[2] proposed unilateral fixation for lumbar fusion firstly through clinical research of the fusion rate in $L_{4/5}$ by unilateral and vertebral fixation. Suk *et al*[3] made a prospective comparison between unilateral and bilateral pedicle screw instrumentation and fusion, found that there was no difference on fusion rate and complication, but operation time, length of stay, medical expenditure and other diversities have statistical significance. Tuttle, Deutsch, and Beringer *et al*[19-21] clinical study verified the excellent effect of unilateral pedicle screw for interbody fusion. Zhou *et al*[22] got interbody fusion rate of 100% by the treatment of unilateral and bilateral pedicle screw plus cage internal fixation for 28 cases. All 51 cases experienced unilateral-exposure, unilateral pedicle screw plus cage interbody fusion, we found that there is no significant difference compared with bilateral interbody fusion in superior rate of operation, length of stay, postoperative complications and rate of interbody fusion, nevertheless operation time, blood loss, medical expenditure are fewer than bilateral fixation.

Compared with bilateral pedicle screw placement, unilateral decompression, single cage plus unilateral pedicle screw instrumentation and fusion are characterized by simple operation (it can reduced by nearly one time), less blood loss, maintain spinous process, interspinous ligaments, supraspinous ligaments and vertebral lamina and articular process in unaffected side, less interference to spine, nerve root and dura cyst, highly stability and less complications, which meets the need of minimally invasive spinal surgery in the future. However, it can not treat Ⅱ degree or above spondylolisthesis (reposition may lead to rotational asymmetry), because its fixation strength is not as good as bilateral fixation, so spondylolysis and those who overweight will be regarded as operation contraindication momentarily. Accordingly, the indication of unilateral internal fixation is disc herniation or lumbar spinal stenosis plus lumbar instability, those need instrumentation and fusion, and only unilateral lower limbs with symptoms, without spondylolysis and Ⅱ degree or above spondylolisthesis.

The shortcoming of this test was that a control group was not designed to compare clinical efficacy between unilateral and vertebral fixation. Thus, further studies need to be carried out.

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单枚 cage 单侧椎弓根螺钉置入内固定治疗退行性腰椎不稳 51 例*

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摘要

背景：既往多采用双侧显露，双侧椎弓根钉置入固定治疗退行性腰椎不稳，手术风险较大，出血较多，手术时间长，费用高。

目的：探讨后路单枚 cage 单侧椎弓根钉置入内固定治疗退行性腰椎不稳的临床效果。

方法：采用后路椎弓根钉及椎间融合器治疗需行内固定融合的退行性腰椎不稳患者 51 例，男 32 例，女 19 例，年龄 41~72 岁；单节段 47 例，双节段 4 例。手术方法均采用单侧显露症状侧椎板及关节突，单侧置入椎弓根钉，经椎间孔入路手术切除椎间盘及软骨终板，植骨后放入单枚 cage。根据日本 JOA 评分法评估术后疗效。

结果与结论：术中出血 90~430 mL；手术时间单节段为 100(85~120) min，　双节段为 150(120~170) min；术后第二三天即可离床活动。术后有 2 例患者腰腿痛无好转，复查 CT 和 MRI 均未见异常，其中 1 例经 3 个月对症处理后腰腿痛减轻，另 1 例无变化。按日本 JOA 评分法评定标准，术前 JOA 评分 11(7~13)分，术后 1 年 JOA 评分 25(18~27)分。94% 患者的 JOA 改善率>50%。51 例患者中融合 44 例，可能融合 7 例，融合时间为 5.4(4.3~7.1) 个月。本组未发现椎弓根螺钉松动、拔出、断钉及 cage 移位。说明单侧椎弓根钉及 cage 内固定手术方法简单，出血少，手术时间短，对脊柱结构破坏少，是治疗退行性腰椎不稳可供选择的较好方法。

关键词：退行性腰椎不稳；椎间融合；单侧；椎弓根螺钉；医学植入物
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