CLINICAL ARTICLE

J Korean Neurosurg Soc 40 : 175-179, 2006

Anterior Lumbar Interbody Fusion with Pedicle Screw Fixation for Elderly Isthmic Spondylolisthesis

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Objective : The surgical outcome of anterior lumbar interbody fusion(ALIF) with pedicle screw fixation for elderly isthmic spondylolisthesis was analyzed.

Methods : Consecutive nineteen elderly patients (aged 65 years or more) with isthmic spondylolisthesis (Grade I or II) who underwent single level ALIF with pedicle screw fixation in 2002 were analyzed. Using clinical chart and mailed questionnaires, preoperative and postoperative Visual Analogue Scale(VAS) of back and leg pain and postoperative Macnab criteria were evaluated.

Results : The mean age at the time of operation was 68.4 years (range 65 to 78 years). Twelve patients underwent ALIF with percutaneous pedicle screw fixation. Seven patients underwent ALIF followed by posterior decompression and pedicle screw fixation. The postoperative complication rate was 10.5% (wound dehiscence in 1 patient and incisional hernia in 1 patient). There was no postoperative major morbidity or mortality. At a mean follow-up duration of 30.7 months (range 25 to 35 months), 93.3% (14 / 15) of the patients showed excellent or good outcomes in terms of Macnab criteria. The mean VAS scores of back pain and leg pain significantly decreased after surgery.

Conclusion : ALIF with pedicle screw fixation yielded favorable results for elderly isthmic spondylolisthesis in selected cases.

KEY WORDS : Anterior lumbar interbody fusion(ALIF) · Elderly · Isthmic spondylolisthesis.

Introduction

The population in Korea is rapidly aging. The average life expectancy in 1983 was 62.3 years for men and 70.5 years for women. However, the average life expectancy in 2002 dramatically increased : 73.4 years of age for men and 80.4 years of age for women. As average life expectancy increases, the number of the elderly patients suffering from spinal disease is also increasing.

Isthmic spondylolisthesis is one of the spinal diseases requiring fusion surgery. Posterior fusion techniques including posterolateral fusion, posterior lumbar interbody fusion(PLIF), transforaminal lumbar interbody fusion and circumferential fusion have usually been performed to treat isthmic spondylolisthesis[11-13,26,30]. The posterior approaches are not associated with the risk of morbidity to the spine that is often seen with anterior fusion. Considering PLIF, a solid interbody fusion, restoration of normal intersegmental alignment and complete neural decompression can be achieved in one stage. However, related complications such as bleeding and neural injury should be considered. In elderly patients, posterior fusion surgery yielded relatively high peri-operative complication rates[1,4,28]. Recently, Lee et al.[15] showed that adult isthmic spondylolisthesis could be successfully treated via anterior approach using anterior lumbar interbody fusion(ALIF) with percutaneous pedicle screw fixation(PPF). In this regard, we supposed that ALIF with pedicle screw fixation might also be a good treatment option for elderly isthmic spondylolisthesis. Therefore, we analyzed the surgical outcome of ALIF with pedicle screw fixation for elderly isthmic spondylolisthesis.

Materials and Methods

We consecutively analyzed 19 elderly patients (aged 65 years or more) with isthmic spondylolisthesis (Grade I or II) who underwent single level ALIF with pedicle screw fixation in 2002. All patients were class II based on American Society of Anesthesiologists(ASA) classification of physical status

• Received : February 22, 2006 • Accepted : June 2, 2006

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(Table 1). Patients who underwent ALIF alone or simultaneous decompression of adjacent segment were excluded in this study. Patients with ASA class III or more were also excluded.

Patient's clinical charts and radiological examinations were reviewed. One radiologist evaluated state of fusion using standing lateral flexion-extension radiography 6 months postoperatively. Absence of motion between the fusion segments on lateral flexion-extension views, no radiolucency in the disc space and formation of a bone bridge connecting the vertebral bodies above and below were regarded as successful fusion. To analyze clinical outcome, preoperative Visual Analogue Scale(VAS) scores of back and leg pain were checked. Using mailed questionnaires, postoperative VAS scores of back and leg pain and Macnab criteria[17] were checked.

Statistical analysis was carried out using SPSS software (Version 12.0). Preoperative and postoperative mean VAS scores were compared using paired sample t test. A two-tailed p value of less than 0.05 was considered significant.

Table 1. The ASA classification of physical status

Class	Definition
I	No systemic disease
II	Mild to moderate systemic disease
III	Severe systemic disease
IV	Severe systemic disease that is life threatening
V	Moribund patient with little chance of survival

ASA : American Society of Anesthesiologists

Surgical technique

When bilateral foraminal stenosis was the main pathology for decompression, ALIF with PPF was performed (Fig. 1)[14,15]. During anterior approach, we considered free passage of probe into the bilateral foramen as an appropriate anterior decompression[14]. When foraminal stenosis was combined with central and/or lateral recess stenosis, ALIF with posterior decompression and pedicle screw fixation(PDPF) was performed (Fig. 2).

Results

Patient characteristics

The male : female ratio was 7 : 12. The mean age of the patients at the time of operation was 68.4 years (range 65 to 78 years). All of them had suffered from low back pain with leg pain and / or neurogenic claudication. The mean duration of symptoms was 46.8 months (range 1 month to 240 months). The affected levels were L4-5 in 16 cases and L5-S1 in 3. Thirteen cases were grade I and 6 cases grade II. All patients underwent bone densitometry before operation and ten of them were diagnosed as osteoporosis (T scores less than -2.5). The patient demographics are summarized in Table 2.

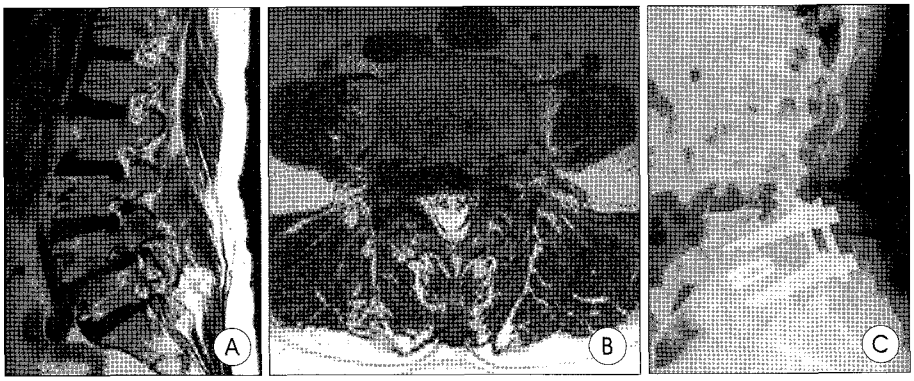

Fig. 1. A 69-year old female underwent anterior lumbar interbody fusion with percutaneous pedicle screw fixation for grade I isthmic spondylolisthesis at L4-5 level. Preoperative magnetic resonance images (A, B) showing bilateral foraminal stenosis at L4-5 level. Standing lateral radiography (C) performed 12 months after operation showed solid fusion at the fused segment.

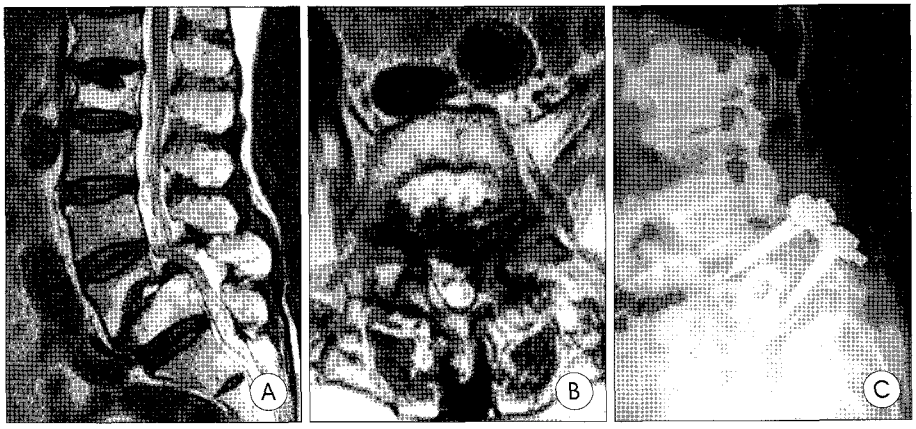

Fig. 2. A 67-year-old female underwent anterior lumbar interbody fusion with posterior decompression and pedicle screw fixation for grade II isthmic spondylolisthesis at L4-5 level. Preoperative magnetic resonance images (A, B) showing foraminal, central and lateral recess stenosis at L4-5 level. Standing lateral radiography (C) performed 15 months after operation showed solid fusion at the fused segment.

Operative data

Twelve patients underwent ALIF with PPF. Seven patients underwent ALIF with PDPF-unilateral laminotomy in 1, bilateral laminotomy in 5 and bilateral facetectomy in 1. Simultaneous posterior decompression was planned preoperatively in 6 cases. In one case, bilateral facetectomy was decided during operation because of incomplete anterior decompression of foraminal stenosis. The mean operation time was

Table 2. The demographics of patients who underwent ALIF with pedicle screw fixation

Characteristics	
Number of cases	19
Sex	
Male	7
Female	12
Mean age (years)	68.4
Range	65-78
Level	
L4-5	16
L5-S1	3
Type of operation	
PPF	12
PDPF	7

PDPF : posterior decompression and pedicle screw fixation, PPF: percutaneous pedicle screw fixation

265.6 minutes (range 195 to 375 minutes). The mean blood loss during operation was 488.4cc (range 200 to 950cc). Blood transfusion was performed in two patients (1 in ALIF with PPF and 1 in ALIF with PDPF). There was no intraoperative complication save for one case of injury to the left iliac artery which was successfully repaired intraoperatively.

Clinical outcome

The mean hospital stay was 12.1 days (range 6 to 31 days). There was no mortality or major morbidity in the peri-operative period. There were two postoperative complications (10.5%); one related to ALIF and one related to pedicle screw fixation. A case of abdominal incisional hernia underwent hernia repair at 5 months after initial operation. Another patient with wound dehiscence at PDPF site underwent debridement of wound at 11 days after initial operation. Both were successfully treated.

Fifteen patients (78.9%) were followed up more than 2 years. Four patients were lost to follow-up. The mean follow-up duration was 30.7 months (range 25 to 35 months). The mean VAS score of leg pain decreased significantly after operation (before operation 7.53 ± 1.85 : at last follow-up 1.13 ± 1.77, $p<0.001$). The mean VAS score of back pain also decreased significantly after operation (before operation 7.33 ± 2.64 : at last follow-up 1.80 ± 2.04, $p<0.001$). Based on the Macnab criteria, 93.3% (14/15) of the patients showed excellent or good outcomes. One patient underwent percutaneous vertebroplasty at L1 due to osteoporotic compression fracture at 14 months after initial operation. Her VAS score of back pain was 6 points at last follow-up and she showed fair outcome.

Radiological outcome

Sixteen (84.2%) of 19 patients underwent follow-up radiological evaluation for six months or more. The mean follow-up period of radiological examination in these patients was 14.8 months (range 6 to 34 months). All sixteen patients showed successful fusion at 6 months after operation. There was no instrument failure at the fused segment during the follow-up period.

Discussion

In this series, we performed ALIF with PPF, when bilateral foraminal stenosis was the main pathology of the patient. Several authors have already demonstrated that isthmic spondylolisthesis could be successfully treated using indirect decompression via anterior approach[2,6,14,15,27]. Restoration of disc height and reduction of anterolisthesis with the placement of cage via anterior approach usually opens the foramen. However, the most important limitation of ALIF is that direct decompression of root is not possible via anterior approach[11]. Therefore, during anterior approach, we used probing to confirm adequate decompression of the foramen. We considered that free passage of probe into foramen after anterior decompression suggested adequate decompression of neuroforamen via the anterior approach[14]. The main advantage of indirect decompression is that decompression can be performed without removing bone or retracting neural structures at all. Therefore patients who underwent ALIF with percutaneous PF usually complained of less degree postoperative back pain than those who underwent posterior fusion methods. The chance of dural injury or root injury during surgery is also lower in ALIF than in posterior fusion methods[22]. When central or lateral recess stenosis was accompanied by foraminal stenosis, we performed ALIF with PDPF. Because decompression of foraminal stenosis and fusion was already performed via anterior approach, we only performed decompression of central and / or lateral recess stenosis via posterior approach, which resulted in less removal of bone and smaller amount of bleeding than those of posterior fusion only or circumferential fusion.

The result of the present study shows that isthmic spondylolisthesis can be successfully treated by ALIF with pedicle screw fixation (PPF or PDPF) even in elderly patients. The clinical outcome of our series was comparable to those of adult patients treated by ALIF[2,6,15,27]. We are of the opinion that good surgical outcome even in the elderly patients can be attributable to our surgical strategy; 1) foraminal decompression and fusion via anterior approach and 2) minimal posterior decompression, if needed. Good general condition (class II based on ASA classification of physical status) of included patients might also affect the surgical outcome of this series.

The anterior portion of the ALIF graft places it into a biomechanically compressive environment that is optimal for fusion[11]. However, several biomechanical studies have demonstrated that anterior fusion alone was insufficient for neutralizing axial rotation and extensional forces[3,5,16,19,21,29]. Therefore, many

surgeons are currently performing ALIF followed by posterior augmentation using pedicle screws or facet screws[7-9,15,20,23]. For isthmic spondylolisthesis, Lee et al. reported high fusion rate (97.3%) of ALIF followed by percutaneous pedicle screw fixation, which was comparable to those of circumferential stabilization[13,15,18,24-26]. The present study shows that high fusion rate can be achieved even in old patients using ALIF with pedicle screw fixation. All sixteen patients who underwent follow-up radiological evaluation for six months or more did not show fusion failure, although nine of them had osteoporosis. As mentioned above, biomechanical stability of ALIF supplemented with pedicle screw fixation might explain this high fusion rate regardless of patient's age.

According to the report of Carreon et al.[1] who analyzed perioperative complications of lumbar decompression and fusion in the elderly, perioperative complication occurred in 79.6% of the total patients and 21.4% of the patients had at least one major complication. They concluded that elderly patients should be made aware that they are at increased risk for surgical complications because of their age. Vitaz et al.[28] who analyzed patients aged 75 years or more who underwent surgery for spinal stenosis also reported high postoperative complication rate; serious postoperative complications in 10% and minor complications in 27%. The postoperative complication rate of ALIF with pedicle screw fixation in the present study was lower than those of posterior fusion methods, considering the patient's age. Furthermore, none of the patients in this series had serious major complications. Anterior approaches do carry some risk of catastrophic injury to major vessels and other retroperitoneal and intraperitoneal structures[10]. For young male patients, the risk of damaging the sympathetic plexus and causing retrograde ejaculation need to be carefully considered[11]. In elderly patients with severe calcified atherosclerosis in abdominal arteries, the possibility of arterial dissection should also be warned. In this series, there were two ALIF related complications : one during operation and one after operation. But both patients were successfully treated and there were no fatal complications. For anterior approach, we have adopted team approach for ALIF. ALIF approach team consisted of well-experienced vascular surgeon (Maeng DH, one of the authors) and two assistants who were able to effectively treat complications such as intraoperative vascular injury. We think that this team approach could explain no ALIF related fatal complications of this series.

Conclusion

In selected cases, successful clinical outcome and fusion rate were achieved for isthmic spondylolisthesis using ALIF with pedicle screw fixation even in the elderly patients.

• Acknowledgement
This study was supported by a grant from the Wooridul Spine Foundation.

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Commentary

Surgical management of symptomatic isthmic spndylolisthesis in elderly patients is quite difficult to choose right procedure due to their age and osteoporosis. Especially spondylotic change is progressed with age and their stability is relative well maintained. Thus, spine surgeon hesitates to do aggressive or invasive procedure in elderly patients. Authors suggested less invasive, but effective surgical option which was published before. Nevertheless authors' successful results, this paper gave us several questions regarding its conclusion. First, what is the definition or criteria of "elderly" patients? As author cited in the text, Vitaz et al. reported surgical treatment of lumbar spinal stenosis in patients older than 75 years of age. Generally patient age more than 70 years-old would be acceptable as an elderly patient in neurosurgical field. It is not sure that 65 years-old is proper as elderly patient criteria. This article leads to another similar question regarding "selected cases". Unfortunately it is hard to find what selected case is in the text. Finally patient population is not even as study group. Surgical procedure mentioned in the title of this paper meant ALIF with percutaneous pedicle screw fixation. Patients with posterior fixation and additional posterior decompression after ALIF were different from other patients who received ALIF and percutaneous PSF. This group may have to exclude for rightful study. Generally, if patient needs decompression and fixation, it is easy to do PSF after posterior decompression at one stage with minimally invasive technique. It is not clear that ALIF is mandatory in such a case that surgeon planned to do posterior decompression and fixation. This paper failed to show the right reason for doing ALIF and posterior decompression. Thus, it is not justifiable to reach the authors' conclusion. It is quite surprising that bone fusion was successful in all patients in spite of old age and osteoporosis at 6 months after operation.

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