


The impact of instrumented lumbar fusion surgery on psychiatric problems in elderly patients with degenerative spinal stenosis

The observational study

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Abstract

This is a prospective cohort study to investigate the effects of instrumented lumbar fusion surgery on psychiatric problems, including anxiety, insomnia, and depression, in patients with degenerative spinal stenosis, as well as on pain and the activities of daily living. Surgery was performed in the patients with Schizas grade C or D spinal stenosis with; if a patient's quality of life was impaired for at least 3 months or if patient had neurologic deficits. Finally, 69 patients were reviewed. Beck anxiety inventory, insomnia severity index, geriatric depression scale short form-Korean, visual analog scale for back pain, visual analog scale for leg pain, and Oswestry disability index was measured on the day surgery was decided on (T1), the day before surgery (T2), the day before discharge (T3), and 6 months after surgery (T4). The patients had mild degrees of anxiety, insomnia, and depression at T1, and Beck anxiety inventory, insomnia severity index, visual analog scale for back pain, visual analog scale for leg pain, and Oswestry disability index improved significantly by T4. In elderly patients with degenerative spinal stenosis, instrumented lumbar fusion surgery improves not only pain and activities of daily living, but also anxiety and insomnia. However, there was no improvement in depression over the 6-month follow-up period.

Abbreviations: BAI = Beck anxiety inventory, GDS-K = geriatric depression scale short form-Korean, ISI = insomnia severity index, MMSE = mini-mental state examination, ODI = Oswestry disability index, SF-36 MCS = the short form 36-item health survey mental component summary, VAS-Bp = visual analog scale for back pain, VAS-Lp = visual analog scale for leg pain.

Keywords: lumbar fusion, psychiatric problems, elderly, spinal stenosis

1. Introduction

Individuals aged 65 and over, who accounted for 16.5% of the Korean population in 2021, are expected to account for 20.3% of the population in 2025, and 43.9% by 2060, due to the rapid aging of the population. The number of patients with chronic spinal disease is also expected to increase with this change in population structure.^[1,2]

Patients with chronic spinal disease experience a decrease in the activities of daily living, limitations in physical activity, and loss of quality of life. These patients commonly have comorbid psychiatric problems such as depression, anxiety, and somatoform disorder.^[3] There have been reports of poor results of surgical treatment in patients with mental health deterioration.^[4–9] In particular, depression and low the short form 36-item health survey mental component summary (SF-36 MCS) score have been identified as risk factors for poor

outcome of lumbar fusion.^[10] Evaluation of the psychiatric problems of these patients before surgery has been found to improve outcome.^[11]

For patients with lumbar spinal stenosis, surgery is an effective treatment for reducing pain and disability.^[12,13] However, there have been few studies of the effects of lumbar fusion on aspects of mental health, such as anxiety, insomnia, and depression.

The authors carried out such a study, on the assumption that if the clinical course following lumbar fusion surgery in elderly patients is positive, surgery will also improve mental health conditions such as anxiety, insomnia, and depression. The purpose of this study was therefore to investigate the effects of instrumented lumbar fusion surgery on psychiatric problems, including anxiety, insomnia, and depression, in patients with degenerative spinal stenosis, as well as on pain and the activities of daily living.

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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2. Materials and methods

2.1. Patient selection

This study was approved by the Institutional Review Board of Hanyang University Hospital (HYUH 2017-06-025). All methods were performed in accordance with the relevant guidelines and regulations. Informed consent was obtained from all participants before surgery.

A total of 77 patients who underwent instrumented lumbar fusion surgery for degenerative spinal stenosis from August 2017 to October 2021 were included. Of these, 8 patients were excluded due to follow-up loss, and a total of 69 patients were included.

The inclusion criteria were elderly patients over 65 years of age who underwent instrumented lumbar fusion for the diagnosis of degenerative spinal stenosis. The exclusion criteria were patients who were considered inappropriate for the study by clinician due to their physical and mental status in the evaluation of dementia and overall mental health. Patients who had revision surgery were also excluded.

2.2. Outcome measurements

Beck anxiety inventory (BAI), insomnia severity index (ISI), geriatric depression scale short form-Korean (GDS-K), visual analog scale for back pain (VAS-Bp), visual analog scale for leg pain (VAS-Lp), and Oswestry disability index (ODI) was measured on the day surgery was decided on (T1), the day before surgery (T2), the day before discharge (T3), and 6 months after surgery (T4). Findings obtained with the psychiatric measurement tools were interpreted as follows; BAI: normal (0–7), mild (8–15), moderate (16–25), severe (26–63).^[14] ISI: normal (0–7), mild (8–14), moderate (15–21), severe (22–28).^[15] GDS-K: normal (1–13), mild (14–18), moderate (19–21), severe (22 and over).^[16] Age, gender, marital status, economic level, duration of spinal stenosis, history of psychiatric disease, and religion were also investigated. In addition, we performed a subgroup analysis comparing clinical outcomes in the Schizas grade C and D spinal stenosis.

Patients were admitted to hospital on the day before surgery. Mental health condition was assessed in cooperation with the department of psychiatry. Patients were treated if therapeutic intervention was necessary, and they were excluded from the study if cognitive impairment, such as dementia, was confirmed by tests such as the mini-mental state examination (MMSE).

2.3. Procedures

All the patients received open transforaminal lumbar interbody fusion with Polyetheretherketone cages, transpedicular fixation and/or posterolateral fusion by the same spine surgeon using a posterior approach at a single medical center.

Surgery was performed in the patients with Schizas grade C or D spinal stenosis that were confirmed by MRI with; if a patient's quality of life was impaired, for example by problems walking, or loss of the ability to perform activities due to persistent pain, despite conservative treatments such as drugs, injections, physical therapy, and exercise therapy for at least 3 months or if patient had neurologic deficits.

2.4. Statistical analysis

A power analysis ($\alpha = 0.05$, power $(1 - \beta) = 0.95$), performed based on a study in 2010 by Abbott et al,^[17] indicated that 69 or more subjects were required. The enrollment target was set at 77.

Statistical analysis was performed with SPSS 25 (SPSS Inc., Chicago, IL) program. Repeated measure ANOVA was used to

analyze variables that changes with time, and logistic regression analysis was used to find out the risk factors associated with the deterioration in depression after surgery. Statistically significance was set at $P < .05$.

3. Results

3.1. Demographic data

The demographic data of the patients are shown in Table 1. The mean age of the patients was 73.29 years, 50 (72.5%) were female and 19 (27.5%) were male. Five (7.25%) patients had histories of psychiatric disease. Of these, 3 had insomnia and 2 had major depressive disorder. Fifty (72.5%) patients were currently married and 19 (27.5%) patients were separated from their spouses due to divorce, separation, or widowhood. The average fusion level was 1.78. 39 patients had Schizas grade C spinal stenosis and 30 patients had grade D spinal stenosis.

3.2. Outcome measurements

The patients had mild degrees of anxiety (14.41 ± 10.02), insomnia (11.30 ± 7.83), and depression (13.55 ± 3.92) at T1, and BAI, ISI, VAS-Bp, VAS-Lp, and ODI improved significantly by T4 compared to T1 (Fig. 1). In a logistic regression analysis conducted by dividing the patients into 2 groups according to whether or not GDS-K worsened between T1 and T4 (Table 2), patients with spouses ($n = 48$) were 5.01 times more likely to have an increased level of depression than those who had separated from their spouses ($n = 21$; $P = .021$). In a subgroup analysis of Schizas grade C and D spinal stenosis, there were no significant differences in change of VAS-Bp, VAS-Lp, ODI, BAI, ISI, and GDS-K between T1 and T4 (Table 3).

3.3. Postoperative complications

Thirty-five out of 69 patients (50.7%) had postoperative complications within 6 months after surgery such as fever ($n = 29$, 42.0%), urinary tract infection ($n = 11$, 15.9%), atelectasis ($n = 11$, 15.9%), delirium ($n = 3$, 4.3%), and etc. There was 1 case (1.4%) of epidural hematoma requiring evacuation procedure (Table 4).

Comparing the groups with and without postoperative complications, there were no significant differences between the 2 groups in the difference in VAS-Bp, VAS-Lp, ODI, BAI, ISI, and GDS-K between T1 and T4 (Table 5).

4. Discussion

Elderly patients with spinal stenosis had mild degree of anxiety, insomnia, and depression before surgery in the present study.

Table 1
Patients demographics.

	N = 69
Age (yr)	73.29 ± 4.88
Gender	Male = 19 (27.5%), Female = 50 (72.5%)
Marital status	Currently married = 50 (72.5%) Separated from their spouses = 19 (27.5%)
Economic status	High = 4, Middle = 42, Low = 23
Duration of spinal stenosis treatment	1–3 yr = 37, 3–5 yr = 12, 5–10 yr = 8, over 10 yr = 12
Current treatment of insomnia	Yes = 9, No = 60
History of psychiatric disease	Yes = 5, No = 64
Religion	Yes = 36, No = 33
Fusion level	1.78 ± 0.92

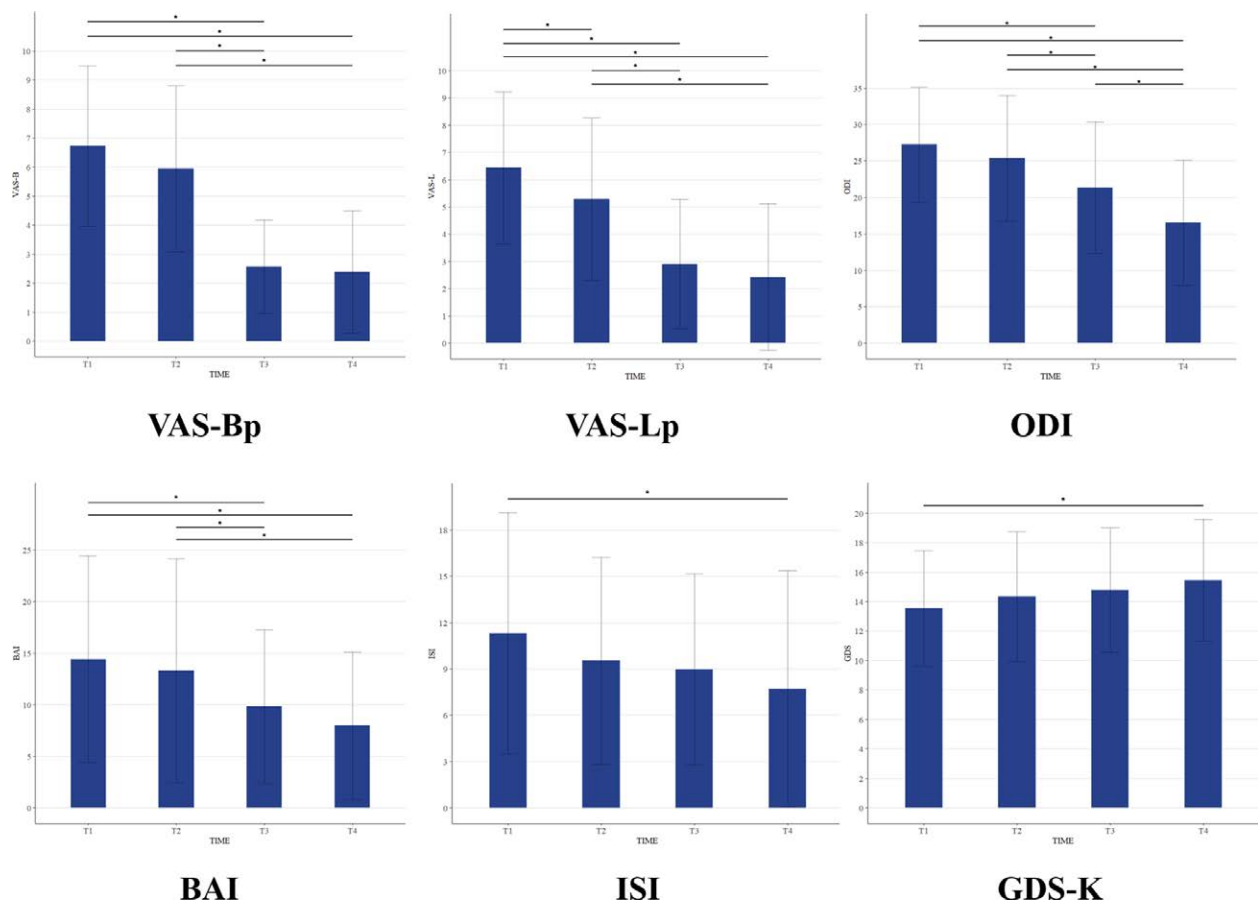


Figure 1. Clinical outcomes at T1, T2, T3, and T4; visual analog scale for back pain (VAS-Bp), visual analog scale for back pain (VAS-Lp), Oswestry disability index (ODI), Beck anxiety inventory (BAI), insomnia severity index (ISI), geriatric depression scale short form-Korean (GDS-K). Horizontal lines with * indicate significant differences and error bars indicate standard deviations.

Table 2
The risk factors associated with the deterioration in depression after surgery.

	Odds ratio	P value
Age (yr)	0.987	.836
Gender	1.019	.979
Marital status	5.011	.021*
Low economic status	0.440	.270
Treatment duration	1.056	.934
Current treatment of insomnia	0.000	.999
History of psychiatric disease	0.000	.999
Religion	0.684	.542

*Significant difference.

BAI was 14.41, and ISI was 11.30, both of which were within the range of mild cases. At T1, the average GDS-K score was 13.55, which was outside the normal range and corresponded to mild depression. These results are in agreement with previous study that psychiatric problems are common in patients with chronic lower back pain.^[3]

The patients showed significant improvements in VAS-Bp, VAS-Lp, ODI, anxiety, and insomnia scores by the 6th month after spinal fusion compared to the date when surgery was decided on. In this study, it was confirmed that surgical treatment improved not only pain and activity of daily living, but also improved anxiety and insomnia in patients with elderly patients with spinal stenosis.

Strom et al^[18] reported in their review article that preoperative and postoperative anxiety and depression in patients

undergoing spine surgery were associated with 5 factors: pain, lack of information, disability, unemployment, and poor mental health. From this it may be inferred that the improvements in anxiety and insomnia scores measured after surgery in this study were influenced by the reductions in pain and disability resulting from the surgery.^[19–21]

No improvement in the depression score after surgery was noted in the present study; instead the depression score was significantly higher in the 6th month after surgery compared with the date of surgery was decided on. However, this increase was not considered clinically significant because the range of mild depression in GDS-K is 14 to 18 points, and no patients in the group with exacerbated depression scores were diagnosed with major depressive disorder.

According to logistic regression analysis, current marital status was the only risk factor which had a significant effect on the exacerbation of depression. However, it is difficult to interpret this influence of marital status since its effect on the outcome of lumbar fusion is unknown and may vary depending on age, gender, country, and cultural area.^[22,23] The following factors were not correlated with the increase of depression in the 6 months after surgery: age, gender, economic status, duration of treatment for spinal stenosis, whether the patient received treatment for insomnia, history of psychiatric disease, whether the patient had psychiatric disease at the time of surgery, and religion.

Bekeris et al^[24] have reported that 6% of patients showed new-onset depression and 11.2% had new-onset anxiety within 6 months after spine surgery and that lower age, female gender, and history of psychosis were risk factors. However, that study has several limitations: it was retrospective and used the ICD-9/10 diagnostic code for analysis, and the results of the

Table 3**Comparison between groups with Schizas grade C and D spinal stenosis.**

Change between T1 and T4	Schizas grade C (N = 39)	Schizas grade D (N = 30)	P value
VAS-Bp	4.28 ± 3.22	4.43 ± 2.96	.840
VAS-Lp	4.38 ± 3.40	3.53 ± 3.73	.333
ODI	12.13 ± 9.82	8.83 ± 10.72	.194
BAI	6.69 ± 9.89	6.10 ± 9.46	.801
ISI	3.41 ± 7.98	3.80 ± 5.94	.817
GDS-K	-2.59 ± 6.25	-1.00 ± 4.65	.230

BAI = Beck anxiety inventory, GDS-K = geriatric depression scale short form-Korean, ISI = insomnia severity index, ODI = Oswestry disability index, VAS-Bp = visual analog scale for back pain, VAS-Lp = visual analog scale for leg pain.

Table 4**Postoperative complications.**

	N = 35
Fever	29 (42.0%)
Urinary tract infection	11 (15.9%)
Atelectasis	11 (15.9%)
Delirium	3 (4.3%)
Screw breakage	2 (2.9%)
Pneumonia	1 (1.4%)
Cerebrospinal fluid leakage	1 (1.4%)
Epidural hematoma	1 (1.4%)
Wound dehiscence	1 (1.4%)

psychiatric analysis of patients with degenerative spinal stenosis were limited as the mean age was in the 50s. In the present study, a prospective study of patients over 65, no patients were diagnosed with major depressive disorders or anxiety disorders in the first 6 months after surgery.

Athiviraham et al^[8] reported that a history of prepsychiatric disease was associated with poor clinical outcomes based on evaluation of clinical outcomes performed 2 years after surgery in patients who underwent surgical treatment for lumbar stenosis. In the present study, exacerbation of depression in the 6th months after surgery was not significantly correlated with a history of psychiatric disorders.

Wahlman et al^[25] reported in a study of 232 patients who underwent lumbar spinal fusion that one-third of the patients had depressive symptoms before surgery, and that their symptoms improved after surgery; disability measured by ODI also improved significantly. In a study of 245 patients who underwent elective surgery for degenerative lumbar spine disease, Wagner et al^[26] reported that the depressed patients had significantly lower ODI and Euro-quality of life-5 dimensions scores at baseline than the nondepressed patients; however, all improved significantly after surgery, and by the 12th month after surgery, the depression levels of the originally depressed patients and the nondepressed patients had converged.

The present study also detected significant improvements in pain, activities of daily living, anxiety, and insomnia after surgery in elderly spinal stenosis patients, even if they still exhibited mild depression. Moreover, the absence of improvement in the depression score is not considered to be a clinically significant deterioration. Therefore, it is not necessary to exclude elderly patients with mild depression from surgical treatment. Furthermore, as there is evidence that the psychological problems of patients prior to lumbar fusion surgery have a negative effect on clinical outcomes after surgery, screening and managing these problems before surgery is recommended.^[27,28] A larger long-term follow-up study of patients with preoperative depression would be desirable to investigate in more detail the course of depression after lumbar fusion surgery.

Table 5**Comparison between groups with and without postoperative complications.**

Difference between T1 and T4	Group with complication	Group with no complication	P value
VAS-Bp	4.63 ± 3.10	4.06 ± 3.10	.447
VAS-Lp	4.57 ± 3.68	3.44 ± 3.36	.188
ODI	11.20 ± 10.10	10.18 ± 10.58	.682
BAI	8.17 ± 8.60	4.55 ± 10.58	.125
ISI	4.69 ± 7.28	2.36 ± 6.97	.184
GDS-K	-2.14 ± 5.11	-1.64 ± 6.29	.716

BAI = Beck anxiety inventory, GDS-K = geriatric depression scale short form-Korean, ISI = insomnia severity index, ODI = Oswestry disability index, VAS-Bp = visual analog scale for back pain, VAS-Lp = visual analog scale for leg pain.

This study had the following limitations; first, the available data were unable to throw much light on the reason that depression, unlike all other indicators, was not improved by surgery. Although married status was associated with an exacerbation of depression, interpretation of this finding will require further study of the effect of married life in the elderly on the surgical course of depression and chronic spinal disease. Second, since this study was not a case-control study and the subjects generally suffered from mild forms of anxiety, insomnia and depression before surgery, it was not possible to compare surgery outcomes by subdividing subjects according to the severity of their initial psychiatric problems. Third, the final follow-up was performed in the 6th month after the surgery, which is a relatively short follow-up period. Further studies with more long-term follow-up are required.

5. Conclusions

In elderly patients with degenerative spinal stenosis, instrumented lumbar fusion surgery improves not only pain and activities of daily living, but also anxiety and insomnia. However, contrary to the authors' expectations, there was no improvement in depression over the 6-month follow-up period.

Author contributions

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