Factors associated with patient satisfaction for PLIF: Patient satisfaction analysis

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Abstract:

Introduction: Posterior lumbar interbody fusion (PLIF) has produced satisfactory clinical outcomes; however, all previous reports have only included evaluations by surgeon-based methods. The purpose of this study was to investigate patient-based surgical outcomes and the factors associated with patient satisfaction for PLIF. Methods: Patients who underwent PLIF for lumbar spondylolisthesis were reviewed (n=443). The average follow-up period was 8 years. Surgical outcomes were assessed using an original questionnaire, a numerical rating scale (NRS), the 36-Item Short Form Health Survey (SF-36), the Japanese Orthopedic Association (JOA) score, and the recovery rate. The original questionnaire consisted of five categories, with patient-evaluated score out of 100 points for surgery, satisfaction, improvement, recommendation to others, and willingness to undergo repeat surgery on a 5-point scale. According to the questionnaire responses, patient-based outcomes were divided into three groups: positive, intermediate, and negative and were compared with the NRS, SF-36, and JOA scores. Furthermore, factors associated with patient satisfaction were examined. Results: A total of 273 patients responded. Response rate was 62%. The average patient-evaluated score for surgery was 82 points. In terms of satisfaction section, positive, intermediate, and negative response rates were 82%, 7%, and 11%, respectively. With respect to other sections, positive, intermediate, and negative response rates were 87%, 7%, and 6% in improvement section; 66%, 23%, and 11% in recommending section; and 72%, 18%, and 10% in repeat section, respectively. The average pre- and postoperative JOA scores were 12 and 24, respectively. Significant correlations were detected between patient-based surgical outcomes and the NRS scores, physical component scores of the SF-36, and the JOA score. Postoperative permanent motor loss and multiple revision surgery were the major factors related to a negative response. Conclusions: High satisfaction rate to PLIF and significant correlation between patient- and surgeon-based surgical outcomes were detected. Postoperative permanent motor loss and multiple revision surgery were the major factors related to a negative response.

Keywords:

PLIF, satisfaction analysis, patient based surgical outcomes, postoperative permanent motor loss, multiple revision surgery

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Introduction

Posterior lumbar interbody fusion (PLIF) can be performed in order to treat lumbar spondylolisthesis, and it provides sufficient decompression of the nerve root and stabilization of the affected segment. PLIF with pedicle screw fixation has produced satisfactory clinical outcomes; however, all the previous reports included only evaluations by surgeon-based methods[1-3)].

It has been reported that patients' and surgeons' perspectives regarding outcomes sometimes differ in clinical fields[4)]. There is an ongoing controversy about the optimal method for evaluating postoperative outcomes of spinal surgeries[5)]. Recently, patient-based evaluation methods have drawn much attention for investigations of effectiveness of treatments in many medical fields[6-13)]. Patient evaluation has become essential for discussion of treatment efficacy. Patient-based surgical outcomes of PLIF were previously reported

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Table 1. Original Questionnaire.

Q1. Please evaluate your surgical results out of 100 points.
Q2. Are you satisfied with the results of the surgery?
Very satisfied
Satisfied
Neither satisfied nor dissatisfied
Dissatisfied
Very dissatisfied
What are you dissatiefied with?
Q3. How has your condition improved since the surgery?
Very improved
Improved
No change
Worsened
Very worsened
What are you worsened with?
Q4. Would you recommend the surgery to family members suffering from the same disease?
Definitely would recommend
Probably would recommend
I don't know
Would not recommend
Definitely would not recommend
Why would you not recommend the surgery?
Q5. If you were to return to the preoperative period, would you still undergo the surgery?
Definitely would undergo
Probably would undergo
I don't know
Would not undergo
Definitely would not undergo
Why would you not undergo the surgery?

for the first time, and a high satisfaction rate was reported[16]. The current study extended the number of patients and also verified the factors associated with patient satisfaction.

Materials and Methods

Subjects

Of 466 consecutive patients who underwent single-segment PLIF for lumbar spondylolisthesis between 1996 and 2008 at a single hospital, 443 patients who completed at least 2 years of follow-up were included in this study. A set of questionnaire forms was mailed to these 443 patients. The protocol was approved by the institutional review board of the hospital, and a written informed consent was obtained from all participants.

Surgical indications and procedures

All patients who underwent surgery had severe, disabling radicular pain with or without low back pain that was unresponsive to conservative treatment.

All PLIF procedures were performed using the technique, which has been previously described[14].

Outcome Measures and Questionnaires

The original questionnaire consisted of five categories, which were also used in the previous report[11,15,16]. The categories were patient-evaluated score for the overall surgical result out of 100, satisfaction with the surgery, improvement with the surgery, recommendation of the surgery to others, and willingness to undergo repeated surgery in the same situation.

The patients were asked to respond to each question using a 5-point scale of answers that included "Very satisfied," "Satisfied," "Neither satisfied nor dissatisfied," "Dissatisfied," and "Very dissatisfied" (Table 1). In accordance with the questionnaire responses, the result was classified as follows: Positive (very satisfied or satisfied), Intermediate (neither satisfied nor dissatisfied), and Negative (dissatisfied or very dissatisfied). In open-type questions, free responses, with reasons for these responses, were requested.

A numerical rating scale (NRS) of 0-5 was used for the lumbar area, buttocks, and legs, where a score of 0 indicated no pain and a score of 5 indicated intolerable pain.

In the 36-item Short Form Health Survey (SF-36), the physical component summary (PCS) and the mental component summary (MCS) scores were evaluated to provide the health-related quality of life outcome.

Table 2. Comparison of Demographics between Responders and Non-responders.

	Responder	Non responder	P value
Age (years)	63.6 (9.9)	63.5 (12.2)	0.9
Sex (Male/Female)	121/152	77/89	0.1
JOA score Pre-op	11.6 (4.4)	11.8 (4.8)	0.6
JOA score Post-op	23.8 (4.3)	23.5 (4.4)	0.5
Recovery rate	71% (22.6)	68% (32.2)	0.3

JOA: Japanese Orthopedic Association. ( ) refers to standard deviation.

Surgeon-based surgical outcomes were assessed using the Japanese Orthopedic Association scoring system (JOA score) pre- and postoperatively[2]. The maximum total JOA score is 29 points. The recovery rate indicated by the JOA score was evaluated using Hirabayashi's method[2] as follows:

Recovery rate of JOA score (%) = (Postoperative score - Preoperative score) ×100/(29 - Preoperative score)

Surgical complications were also investigated. Surgical complications in this study were defined as spine-specific complications, such as surgical-site infection, loss of motor function, adjacent segmental disease (ASD), implant failure, and nonunion. Complications that were not specific to spine surgery or did not affect recovery were excluded. There was no surgical-site infection in the present series. Loss of motor function was defined as less than level 3 on manual muscle testing. Furthermore, loss of motor function was subclassified based on whether it was reversible (temporary motor loss) or irreversible (permanent motor loss). Although loss of motor function that was observed before surgery and did not recover after surgery was not considered as a complication, this condition was included as an independent variable in the analysis (residual motor loss). ASD was defined as a symptomatic condition in which revision surgery was required to treat neurological deterioration at the adjacent degenerative segment on the radiograph. Nonunion was defined as a radiographic condition in which bony continuity between graft bone and vertebra was not detected on plain radiographs or reconstructed computed tomography, with loosening of pedicle screws or apparent motion at the fused segment on dynamic lateral radiographs for more than 2 years. Multiple revision surgery was defined as a condition in which lumbar surgeries were required more than three times. Although surgeries undergone before primary PLIF were not considered a complication, all lumbar surgeries were counted if the operated segment was the same as that of the primary PLIF.

JOA scores and radiological data were obtained for all patients before surgery and at 6, 12, 18, 24 months after surgery and then, annually. JOA scores and recovery rates were described at the final follow-up assessment.

Statistical analysis

Clinical data were compared using one-way analysis of variance with a *post hoc* Bonferroni test for multiple comparisons. The χ^2 test was used for categorical outcome variables. An alpha level of 0.05 was considered significant. SPSS (version 20; IBM, Armonk, NY, USA) was used for statistical analysis.

Multivariate regression analysis was performed to identify factors correlated with patient satisfaction. The patient-evaluated score for surgery was used as an independent variable. A multiple linear regression model with a stepwise backward selection method was used. Collinearity and residual diagnostics were performed.

Results

Patient demographics

Of the 443 patients who were sent questionnaires, 277 (65%) responded. Of them, four patients whose JOA score was unavailable were excluded. Finally, 273 patients (121 men and 152 women) were included in the study. The average age at surgery was 63.6 years (range, 22-83 years). The male/female ratio was 121/152. Average pre- and postoperative JOA scores were 11.6 points (range, 3-25 points) and 23.8 points (range, 11-29 points), respectively. The average recovery rate was 71% (range, -13% -100%).

There was no significant difference in age, sex, pre/postoperative JOA score, or recovery rate between the responders and the non-responders (Table 2).

In terms of preoperative radiological findings, the average percent slip was 18% (range 8%-44%). The levels of surgery were L3-4 in 42 patients, L4-5 in 190 and L5-S1 in 41.

Patient-based surgical outcomes

The average patient-evaluated score for surgery was 82 points (range, 0-100 points) (Table 3). In terms of satisfaction section, positive, intermediate, and negative response rates were 82%, 7%, and 11%, respectively (Figure 1). With respect to other sections, positive, intermediate, and negative response rates were 87%, 7%, and 6% in improvement section; 66%, 23%, and 11% in recommending section; and 72%, 18%, and 10% in repeat section, respectively.

Postoperative NRS scores by satisfaction

In the positive group, each pain score of the low back, buttock, and leg was 1.0, 1.0, and 1.5, respectively (Table 3). Each pain score was 2.6, 2.1, and 2.3 in the intermediate group and 2.5, 2.5, and 3.4 in the negative group, respectively. The negative group had significantly worse pain in all parts of NRS compared with the positive group ($p<0.001$).

Health-related outcomes by satisfaction

Postoperative PCS was 35 in the positive group, 22 in the intermediate group, and 13 in the negative group (Table 3). There were significant differences in the PCS scores between the positive and intermediate groups ($p=0.029$) and between the positive and negative groups ($p=0.001$). There was no significant difference in the postoperative MCS

Table 3. Comparison of Patient-based and Surgeon-based Surgical Outcomes by Satisfaction.

		Total N=273	Pos. N=224	Int. N=19	Neg. N=30	P value		
						Pos-Int	Pos-Neg	Int-Neg
Patient's op score		82	89	66	38	0.001<	0.001<	0.001<
NRS	Low back	1.2	1.0	2.6	2.5	0.003	0.001<	1.000
	Buttock	1.1	1.0	2.1	2.5	0.075	0.001<	1.000
	Leg	1.8	1.5	2.3	3.4	0.245	0.001<	0.081
SF36	PCS	30.1	35	22	13	0.029	0.001<	0.400
	MCS	53.1	53	47	48.0	0.130	0.100	1.000
Preop. JOA		11.8	11.8	9.7	10.8	0.105	0.889	1.000
Postop. JOA		23.8	24.8	21.3	17.7	0.002	0.001<	0.013
Recovery rate (%)		71	76	59	37	0.005	0.001<	0.003

NRS: numerical rating scale, PCS: physical component summary, MCS: mental component summary, SF-36: the 36-Item Short Form Health Survey, JOA: Japanese Orthopedic Association score, Pos: patients with positive response, Int: patients with intermediate response, Neg: patients with negative response.

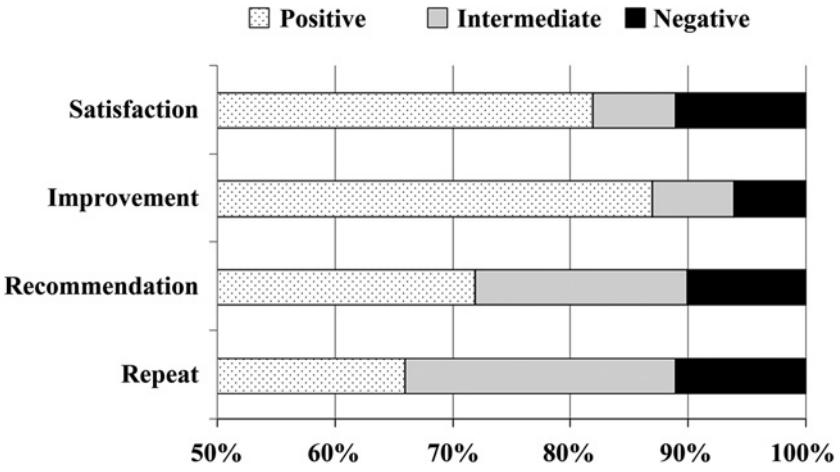

Figure 1. Patient-based surgical outcomes.

scores among the groups.

JOA scores by satisfaction

There was no significant difference in the preoperative JOA scores among the groups. The postoperative total JOA score was 24.8 in the positive group, 21.3 in the intermediate group, and 17.6 in the negative group (Table 2). There was a significant difference in the total JOA scores among the groups (p<0.002). The positive group had significantly better postoperative scores in all domains of the JOA score than the negative group. There were also significant differences in the recovery rate of the JOA scores among the groups (positive 76%, intermediate 59%, and negative 37%; p<0.001).

Correlations between patient- and surgeon-based surgical outcomes

Although no correlation was observed between the questionnaire and the preoperative JOA score, significant correlations were detected between all domains of the questionnaire and the postoperative JOA score and the recovery rate. There were particularly significant correlations between the recovery rate and the patient-evaluated score for surgery (R= 0.610, p values <0.001) (Figure 2). Furthermore, there were significant correlations between all domains of the questionnaire and the buttock and leg pain scores of NRS and PCS.

Postoperative complications

Loss of motor function due to the surgical procedure occurred in 19 patients (19/273: 7.0%) (Table 4). Fourteen patients (5.1%) had temporary motor loss and recovered fully, whereas five patients (1.8%) had permanent motor loss. Of the 14 patients with temporary motor loss, 12 were in the positive group (5.4%) and 2 (11%) in the intermediate group. (P=0.24) All 5 patients with permanent motor loss were in the negative group (P<0.001).

Twenty-two patients demonstrated residual motor loss with no postoperative recovery of motor function that was present before surgery. Of the 22 patients, there were 12 patients (5.4%) in the positive group, 2 patients (11%) in the intermediate group, and 8 patients (26.7%) in the negative group (p<0.001).

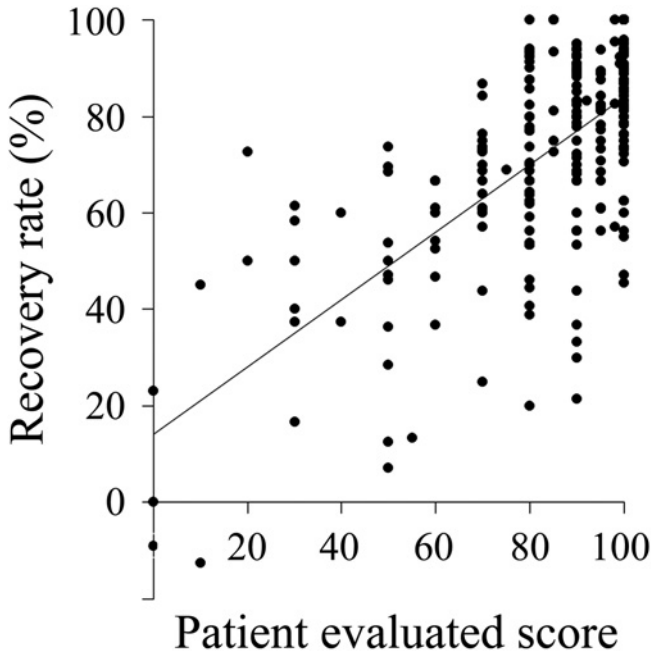

Figure 2. Correlations between patient-based and surgeon-based surgical outcomes. There is a significant correlation between the recovery rate and the patient-evaluated score (R=0.610, P<0.001).

ASD occurred in 16 patients (16/273: 5.9%). There were 11 patients (4.9%) in the positive group and 5 (16.7%) in the negative group (p=0.018). After the revision surgery at the adjacent segment, all patients improved. The mean period between the primary and revision surgeries was 5.5 years (range, 2-9 years).

Pedicle screw breakage or back out occurred in five patients. Of the five patients with implant failure, four patients (1.8%) were in the positive group and one (3.3%) in the negative group (P=0.69).

Nonunion was observed in seven patients (7/273: 2.6%). Of the seven patients, six asymptomatic patients were satisfied with the surgery. However, the other patient complained of severe low back pain and underwent revision surgery. This patient was dissatisfied with the surgery.

Multiple revision surgery was performed in nine patients. Of these nine patients, revision surgery was performed in five patients due to repeated ASD at the adjacent segment of the primary PLIF, twice in two patients at the same segment and the adjacent segment subsequently (1st fenestration at L4-5, 2nd PLIF at L4/5, and 3rd PLIF at L3/4), three times in one patient at the same segment (1st fenestration, 2nd laminectomy, and 3rd PLIF at L4/5), and three times in one patient at the same segment for nonunion. There were five patients (2.2%) in the positive group and four (13.3%) in the negative group (p=0.044). These four patients in the negative group underwent revision surgery at the same segment as that at primary surgery, while all five patients in the positive group underwent adjacent segment surgery.

With respect to multiple complications, ASD with multiple revision surgery was observed in seven patients, ASD with residual motor loss in three, ASD with nonunion in two, nonunion with multiple revision surgery in one, and permanent motor loss with implant failure in one. Of these 14 patients with multiple complications, 9 patients were in the positive group and 5 in the negative group. These 5 patients in the negative group showed motor loss or multiple revision surgery at the same segment.

Table 4. Comparison of Complications by Satisfaction.

	Pos. N=224	Int. N=19	Neg. N=30	P value
	Case (%)			
Permanent motor loss	0	0	5 (16.7)	<0.001
Temporary motor loss	12 (5.4)	2 (11)	0	0.24
Residual motor loss	12 (5.4)	2 (11)	8 (26.7)	<0.001
ASD	11 (4.9)	0	5 (16.7)	0.018
Implant failure	4 (1.8)	0	1 (3.3)	0.69
Nonunion	6 (2.7)	0	1 (3.3)	0.75
Multiple revision surgery	5 (2.2)	0	4 (13.3)	<0.001

ASD: adjacent segment degeneration, Pos: patients with positive response, Int: patients with intermediate response, Neg: patients with negative response.

Logistic Regression Analysis

The recovery rate of the JOA score, the NRS scores of all parts, and all complications were entered into a stepwise logistic regression analysis model, with patient-evaluated score for surgery as the dependent variable. The following variables were identified as independent variables: recovery rate of the JOA score, NRS score of leg pain, permanent motor loss, residual motor loss, and multiple revision surgery (Table 5). The five variables accounted for 56% of the variability in the patient-evaluated score for surgery.

Discussion

Although many reports have described the surgical outcomes of PLIF[1-3,19-25], there have been no patient-based satisfaction analyses of PLIF. Patient-based surgical outcomes of PLIF for lumbar spondylolisthesis were previously reported for the first time[15,16]. The current study extended the number of patients in order to verify the factors associated with patient satisfaction.

In the present study, the average patient-evaluated score for surgery was 82 of 100 points. With respect to the satisfaction and improvement sections, positive responses were demonstrated in more than 80% of patients. Furthermore, there were significant correlations between the JOA score and patient-based surgical outcomes. Even though the number of patients has increased to 2.7 times compared with the previous report (from 103 to 273 cases), similar results were obtained.

On the other hand, permanent and residual motor losses were major reasons for negative responses, similar with the previous report. Especially, negative response in the improvement section was a serious problem for surgical out-

Table 5. Multiple Regression Model for Patient Satisfaction with Overall Points for Surgery Scored by the Patients as the Dependent Variable. (adjusted R^2=0.547)

Independent variables	Scale	Unstandardized Coefficients (B)	Standardized Coefficients (Beta)	P value
Recovery rate	-13 to 100	0.369	0.442	<0.001
Permanent motor loss	1 or 0	-32.7	-0.245	<0.001
Residual motor loss	1 or 0	-2.2	-0.174	0.001
NRS of leg	0-5 point	-10.6	-0.142	0.004
Multiple revision surgery	1 or 0	-28.3	-0.165	0.001

NRS: numerical rating scale.

comes of PLIF. In the improvement section, 15 patients (6%) gave negative responses, although there were 2 (0.7%) patients with a recovery rate less than 0%. According to the present results, all five patients with postoperative permanent motor loss gave negative responses. Furthermore, patients with persistent preoperative motor loss that persisted postoperatively tended to show negative responses if postoperative neurological deterioration was not observed. Postoperative motor loss and residual motor loss were major factors related to negative responses. In addition, patients with leg pain on NRS gave negative responses. All patients with negative responses in the improvement section demonstrated negative responses to the other sections.

Multiple revision surgery has been discussed as one of the major factors related to worse clinical outcomes[17,18]. The present study's results are similar to those reported previously. Of all nine multiple revision surgery patients in the present series, four (44%) were in the negative group. These four patients in the negative group underwent revision surgery at the same segment as that at the primary surgery. Multiple revision surgery at the same segment appeared to contribute to the negative response if no postoperative motor loss occurred.

ASD is one of the most important sequelae affecting the long-term outcomes after PLIF. ASD has been previously examined with a review of earlier reports[19,20]. Previous reports had ASD rates ranging from 1.4% to 18.5%[19-29]. In the present series, all ASD patients without residual motor loss or multiple revision surgery at the same segment experienced improvement in their deteriorated symptoms after revision surgeries; furthermore, both patient- and surgeon-based surgical outcomes were almost equal in patients without ASD. On the other hand, negative responses were significantly more common in ASD patients with residual motor loss (two of three patients; 67%) and multiple revision surgery at the same segment (all two patients). The present findings suggest that the final condition contributed to both patient- and surgeon-based surgical outcomes.

There were some limitations in the present study. First, correlation between radiological parameters such as alignment or reduction of olisthesis and patient-based surgical outcomes was not investigated. Second, the non-responder rate was 38% because of patient death or change of address. Third, there was a wide range during the follow up periods (2-20 years), which means time for administration of the patient-based and surgeon-based surgical outcomes was different. However, our previous report was examined five years after surgery. Both patient- and surgeon-based outcomes and present results were similar to our previous report regarding the questionnaire and correlation between patient- and surgeon-based outcomes. Although the patient number has increased compared to our previous report, almost the same results were observed in the present study.

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Conflict of Interest: The authors declare that there are no conflicts of interest.

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