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Lumbar Spinal Fusion Affects Sitting Disability on the Floor

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ABSTRACT

Background: Lumbar spinal fusion is a standard of care for certain lumbar spinal diseases. However, its impact on sitting, especially on the floor, has not been assessed, even in the countries where people usually sit on the floor instead of using a chair.

Methods: A total of 100 Korean patients who underwent lumbar spinal fusion and 47 patients who underwent decompression surgery were enrolled. In a postoperative Oswestry Disability Index (ODI) questionnaire, an additional section 11 (Sitting on the Floor) was inserted, in which the phrase "sitting in a chair" of section 5 was replaced with "sitting on the floor." The ODI scores were calculated twice using either the section with "sitting in a chair" or the section with "sitting on the floor" and comparing the two.

Results: In the fusion group, the mean postoperative ODI calculated with "sitting on the floor" is significantly worse than that with "sitting in a chair" ($P < .0001$). This difference was the same regardless of whether the fusion was done at a single level ($P < .0001$) or 2 or more levels ($P = .006$) or whether location was at L4-L5 ($P = .002$) or L5-S1 ($P = .02$) in a single-level fusion. The scores of the decompression group showed no difference. Though preoperative and postoperative ODI showed no difference between groups, the postoperative ODI using "sitting on the floor" was significantly worse in the fusion group than the decompression group ($P = .009$).

Conclusion: ODI scores using "sitting on the floor" after lumbar fusion were significantly worse than those with "sitting in a chair." A sitting disability on the floor after lumbar arthrodesis has not been appreciated adequately so far and should be seriously considered if a lumbar arthrodesis is planned in a society where people's usual style of sitting is on the floor.

Lumbar Spine

Keywords: back disability, lumbar spinal fusion, Oswestry Disability Index, sitting on the floor

INTRODUCTION

Spinal arthrodesis has been used for decades in the treatment of a variety of spinal diseases. However, significant complications and morbidity associated with it, especially in the treatment of degenerative spinal diseases, have raised questions on its efficacy.[1–3] In efforts to prevent the complications of spinal fusion, numerous nonfusion spinal implants have been developed, have gained some enthusiasm in last decade, and have replaced spinal fusion in some spinal disorders.[4] Nonetheless, spinal arthrodesis is still regarded as the standard of care for certain spinal diseases,[5–9] and, though dispute on its efficacy continues, the trend of spinal arthrodesis in the United States has increased markedly, increasing 2.4-fold from 1998 to 2008.[10] This trend might not be limited to the United States but, in fact, might reflect a worldwide trend.

In clinical practice in Korea, however, it is not uncommon to see patients who complain of severe back stiffness and significant limitation of daily activities after lumbar spinal fusion. Those patients are dissatisfied with the surgery in spite of improvement of their back and leg pain, complaining that they were handicapped after the surgery and regret their treatment. They say that they would never have undergone such a surgery if they had known about the limitations they would suffer. This is perplexing because most of the literature on spinal arthrodesis describes favorable fusion success and clinical outcomes. Though clinical outcomes of spinal fusion reported from Korea have always been favorable,[11–13] it is difficult to find Korean patients in clinical practice who are completely satisfied and complaint-free after lumbar spinal fusion.

Regarding this phenomenon, we had two questions: Do Korean people feel more disability after lumbar spinal arthrodesis than do people from Western countries? If so, what is the reason? We postulated that if there was any difference in the

perception of back disability after lumbar fusion between Korean people and people from Western countries, the reason might lie in lifestyles and, more specifically, in the sitting style. Unlike in Western countries where people sit in a chair, people in Korea, especially in rural areas, usually sit on the floor. Given that lumbar spinal fusion may make their backs stiff and make prolonged sitting on the floor difficult, the cultural lifestyle forcing them to sit on the floor for hours might make them feel much more disabled in their daily lives and negatively influence patient satisfaction.

Disability as it relates to sitting on the floor, however, has never been assessed.[14–17] Even the Japanese Orthopaedic Association outcome scale score from Japan, where the sitting style is similar to that in Korea, lacks evaluation of any difficulty in sitting on the floor.[18,19] Among outcome measures that are frequently used in clinical practice, only the Oswestry Disability Index (ODI) contains a section referencing a disability in sitting. However, the sitting is assessed in a chair and not on the floor.[15] Because a disability related to sitting on the floor has never been thought important in Western culture, where people usually sit in chairs and from which most of the back-specific outcomes questionnaires were developed, there is no outcome questionnaire that measures disability as it relates to sitting on the floor. If the disability after a surgery is worse when sitting on the floor than in a chair, clinical outcomes evaluated with a questionnaire measuring only disability when sitting in a chair will likely underestimate the real disability perceived by patients in a society where people usually pass time sitting on the floor. The purpose of the current study is to verify whether the perception of back disability after lumbar spinal fusion is different if the back questionnaire asks about sitting on the floor and thereby to identify if the perceived disability after lumbar spinal fusion could be affected by a culturally different style of sitting.

MATERIAL AND METHODS

Patient Population

Of the patients who underwent spinal fusion from 2003 to 2010 and were regularly followed in our institute in Korea, 100 consecutive patients were enrolled. For reference, to see whether there is also any difference between sitting in a chair or on the floor after nonfusion lumbar surgery, 47 patients who underwent decompression surgery from 2007 to 2010 were enrolled as well. Primary diagnoses in the fusion group were degenerative (n = 45) and lytic (n = 33) spondylolisthesis, degenerative disc disease (n = 10), spinal stenosis (n = 8), recurrent disc herniation (n = 2), and discitis (n = 2). Procedures included anterior lumbar interbody fusion with percutaneous screw fixation (n = 83), minimally invasive transforaminal lumbar interbody fusion (n = 12), and posterior lumbar interbody fusion (n = 5). Primary diagnoses of the decompression group were herniated disc (n = 38) and spinal stenosis including foraminal and extraforaminal stenosis (n = 9). Procedures included microdiscectomy (n = 38) and microscopic decompressive laminotomy and foraminotomy (n = 9). Patients who had surgery for tumor resection, either benign or malignant, and those who were followed fewer than 6 months were excluded from the study.

Data Method

The patients were enrolled at the time of their regular follow-ups and were asked to answer a postoperative questionnaire. Our regular postoperative questionnaire included a visual analog pain scale (VAS) collected for back and leg pain, the ODI, subjective symptom improvement rate, satisfaction with surgery, the reason for dissatisfaction if dissatisfied, willingness to undergo the surgery again, and whether they had returned to their previous daily activities and jobs. The Korean version of the ODI by Kim et al[20] was used in the study. We included section 8 (sex life), differently from Kim et al, because we believed that sex life contains an important aspect of disability caused by back pain. For the study, an additional section asking about sitting on the floor (section 11) was inserted at the end of the ODI questionnaire, in which the phrase "sitting in a chair" in section 5 was replaced with "sitting on the floor." The ODI scores were calculated twice, once using section 5 and once using section 11, and the scores were compared with each other. The data were analyzed using the Mann-Whitney *U* test, independent samples *t* test, paired samples *t* test, Wilcoxon signed rank test, and chi-square test when appropriate. A P value of $<.05$ was considered statistically significant.

RESULTS

Mean age of the fusion group was 59.4 years (range, 24–77 years) and the mean follow-up period was 22 months (range, 8–90 months; Table 1). There were 74 women and 26 men. Fused levels were from L2 to S1. A total of 71 patients underwent single-level fusion, 22 had 2 levels fused, 6 had 3 levels, and 1 had 4 levels. Mean age of the decompression group was 58 years (range, 26–78 years) and mean follow-up period was 23 months (range, 9–39 years). There were 30 women and 17 men. Forty-one patients underwent single-level surgery and 6 had double-level surgery.

The mean original postoperative ODI score calculated with the section "sitting in a chair" of the fusion group was 30.16 (range, 0–84.4). The score became significantly worse if calculated with the section "sitting on the floor" (34.61; range, 0–84.4, $P < .0001$; Table 2). The mean score of the section "sitting in a chair" of the postoperative ODI questionnaire of the fusion group was 1.59 (range, 0–4), and the score of the section "sitting on the floor" was 2.47 (range, 0–5); the score of "sitting on the floor" was significantly worse ($P < .0001$). In the decompression group, the mean original postoperative ODI score (26.17; range, 0–64.0) and the score using the section '"sitting on the floor" (26.68; range, 0–62.0) were not statistically different ($P = .053$). The mean score of the section "sitting in a chair" and the section "sitting on the floor" of the decompression group were 1.34 and 1.45 (range, 0–4, respectively), without a statistical difference ($P = .166$).

Though disease entities were different in the fusion and the decompression groups, the mean preoperative ODI scores (fusion: 60.97; range, 24–97.8; and decompression: 58.61; range, 10–95.56) were not statistically different between groups ($P = .624$; Table 3). Those scores in each group significantly improved after the surgery ($P < .0001$, respectively). However, whereas the postoperative ODI scores using the section "sitting in a chair" were not significantly different between the 2 groups ($P = .139$), the scores calculated with the "sitting on the floor" section were significantly worse in the fusion group ($P = .009$; Table 2). Again, the mean preoperative scores of the "sitting in a chair" section were 2.92 (range, 0–5) in the fusion group and 2.91 (range, 0–5) in decompression group without statistical difference ($P = .965$) and the postoperative scores of the "sitting in a chair" section were not different between the fusion and decompression groups (1.59 and 1.34, respectively, $P = .160$; Tables 2 and 3). However, the postoperative scores of the "sitting on the floor" section were significantly worse in the fusion group (2.47 vs 1.45, $P < .0001$; Table 2). Though preoperative ODI scores were not significantly different, mean preoperative and postoperative VAS scores of back pain were worse in the fusion group (6.90 and 4.16, respectively) than the decompression group (5.55 and 3.32, respectively, and $P = .001$ and .025, respectively), and those VAS scores of back pain significantly improved after the surgery in each group ($P < .0001$, respectively; Table 3). Whereas 78.7% of the decompression group responded that they returned fully to their previous daily activities, only 48% of the fusion group responded they did ($P < .0001$, chi-square test).

Table 1. Patient demographics.

Characteristic	Fusion (n = 100)	Decompression (n = 47)	*P* Value[a]
Mean age (range)	59.4 y (24–77 y)	58.0 y (26–78 y)	.402
Sex (female:male)	74:26	30:17	NA
Mean follow-up (range)	22 mo (8–90 mo)	23 mo (9–39 mo)	.052
Surgical levels (n)	1 (71) 2 (22) 3 (6) 4 (1)	1 (41) 2 (6)	NA

[a]Mann-Whitney *U* test; ellipses indicate data not applicable.

The fusion group was further divided to see whether the difficulty in sitting on the floor was different according to number of fused segments or location of the fusion. First, there was no statistically significant difference in postoperative ODI scores between a single-level fusion (n = 71) and a fusion of 2 or more levels (n = 29; ODI = 29.33 and 32.19, respectively, $P = .435$; Table 4). Both subgroups showed statistically significant worsening of the ODI scores if calculated with the section "sitting on the floor" (33.2 and 38.08, respectively, $P < .0001$ and .006, respectively). The ODI scores calculated with the section "sitting on the floor" were not significantly different between fusion of a single level and of 2 or more levels ($P = .245$).

Second, the patients with single-level fusions were then further divided according to location to see whether the sitting disability on the floor is affected by the location of fusion. Because the number of patients who had surgery at L2-L3 (n = 2) and L3-L4 (n = 5) was not enough for valid statistical analysis, only the patients who had surgery at L4-L5

Table 2. The postoperative (postop) Oswestry Disability Index (ODI) scores.

Section	Fusion, n = 100 Mean Values (Range)	Decompression, n = 47 Mean Values (Range)	*P* Value
Postop ODI with "sitting in a chair"	30.16 ± 16.50 (0–84.4)	26.17 ± 16.23 (0–64.0)	.139[a]
Postop ODI with "sitting on the floor"	34.61 ± 17.32 (0–84.4)	26.68 ± 16.34 (0–62.0)	.009[a]
P Value	.000[b]	.053[b]	
Postop score of section "sitting in a chair"	1.59 ± 1.01 (0–4)	1.34 ± 0.84 (0–4)	.160[c]
Postop score of section "sitting on the floor"	2.47 ± 1.40 (0–5)	1.45 ± 0.95 (0–4)	.000[c]
P Value	.000[d]	.166[d]	

[a]Mann-Whitney *U* test.
[b]Paired samples *t* test.
[c]Independent samples *t* test.
[d]Wilcoxon signed rank test.

(n = 36) and L5-S1 (n = 28) were analyzed (Table 5). There was no statistical difference in postoperative ODI scores between the groups that had the fusion at L4-L5 and the fusion at L5-S1 (29.42 and 27.96, respectively, $P = .728$). Both groups showed statistically significant worsening of the ODI scores if calculated with the section "sitting on the floor" (33.45 and 31.05, respectively, $P = .002$ and .02, respectively). Again, the ODI scores calculated with the section "sitting on the floor" were not significantly different between fusion at L4-L5 and fusion at L5-S1 ($P = .570$).

DISCUSSION

In Asian countries, especially in rural areas of Korea and Japan, the people sit on the floor at their homes without using chairs. They pass the time, play games with friends or family, and dine while sitting on the floor. They do household chores and even outside work sitting on the floor (or ground) or squatting. This lifestyle affects the back health of the people of those countries in a peculiar way. Degenerative flat back syndrome, for example, also known as lumbar degenerative kyphosis, is regarded as a peculiar spinal disease related to the lifestyle of the people in those countries. It is a quite common disease in Korea and Japan but has been relatively unknown to Western countries.[21,22] Lifestyle in those Asian countries as it relates to back health other than this disease, especially regarding postoperative disability, has not been seriously considered and studied so far.

Most back-specific outcome measures were developed in Western, English-speaking countries (ie, the United Kingdom, Canada, and the United States).[23] It is recognized that the outcome measures, in order to be valid in a new country and culture, should be translated and tested for a cross-cultural adaptation. Beaton et al[24] described guidelines for the process of cross-cultural adaptation. The guideline was to make an equivalent metric that provides a valid measure of another culture's health, and therefore the importance of wording of the questionnaires was emphasized to maintain the nuances of a different language and culture. Following this guideline, outcome questionnaires were validly translated into many languages.[20,25–27] The process of cultural adaptation, however, involves only translation of proper wording without reflection on a culturally different lifestyle. This can result in ignorance of the limitations on an activity that might be more important in the new culture into which the questionnaire was translated than in the culture from which the questionnaire was originally developed. For example, the Korean

Table 3. Comparison of preoperative (preop) and postoperative (postop) Oswestry Disability Index (ODI) scores and visual analog scale (VAS) scores.

Measure	Fusion, n = 100 Mean Values (Range)	Decompression, n = 47 Mean Values (Range)	*P* Value
ODI			
Preop	60.97 ± 15.92 (24–97.8)	58.61 ± 18.42 (10–95.56)	.624[a]
Postop	30.16 ± 16.50 (0–84.4)	26.17 ± 16.23 (0–64.0)	.139[a]
P value	0.000[b]	0.000[b]	
Preop scores of section "sitting in a chair"	2.92 ± 1.21 (0–5)	2.91 ± 1.33 (0–5)	.965[a]
VAS (back pain)			
Preop	6.90 ± 2.01 (2–10)	5.55 ± 2.50 (0–10)	.001[a]
Postop	4.16 ± 2.57 (0–10)	3.32 ± 2.04 (0–7)	.025[a]
P value	0.000[b]	0.000[b]	

[a]Mann-Whitney *U* test.
[b]Paired samples *t* test.

Table 4. Comparison of postoperative Oswestry Disability Index (ODI) scores of single-level vs. multiple-level fusion.

Level of Fusion (n = 100)	Postop ODI with "Sitting in a Chair," Mean Values	Postop ODI with "Sitting on the Floor," Mean Values	*P* Value
Single (n = 71)	29.33 ± 16.06	33.20 ± 16.14	.000[a] (<.0001)
Multiple (n = 29)	32.19 ± 17.65	38.08 ± 19.80	.006[a]
P value	.435[b]	.245[b]	

[a]Paired *t* test.
[b]Independent *t* test.

version of ODI lacks consideration of the unique lifestyle of the Korean people, who spend most of their time sitting on the floor. Sitting on the floor may not be important at all in the culture where the ODI questionnaires were originally developed, but it is an important issue in Korean society in terms of social activity, because typical restaurants in Korea provide tables of low height on the floor without any chairs. Almost all social gatherings in Korea are held in such restaurants, and the people have to sit on the floor for a couple of hours to attend such meetings. An outcome questionnaire, to be valid and proper, should measure all domains of disability (ie, impairment at the body level, activity limitations at the personal level, and any participation restriction at the social level).[23] Given that the social life of Korean people is significantly influenced by their ability to sit on the floor for a prolonged period of time, the ODI, which does not measure restriction in sitting on the floor, may not be sufficient to properly evaluate the Korean patient.

The current study corroborates that in the fusion group, postoperative disability scores related to sitting on the floor were worse than those for sitting in a chair. This may explain why Korean patients with lumbar spinal fusion frequently are dissatisfied with their treatment in spite of a successful surgery. It may be argued that though the ODI scores pertaining to the style of sitting in the fusion group were statistically different, the difference was too small (only 4.45) to have clinical significance. But if the literal meaning of the scores of the section is considered, the significance may be profound. The mean score of the section for sitting in a chair was 1.59 and the score of the section for sitting on the floor 2.47. The average score of 1.59 literally means that the disability is somewhere between "Pain prevents me from sitting for more than 1 hour" and "I can only sit in my favorite chair as long as I like"; the average score 2.43 means that the disability is somewhere between "Pain prevents me from sitting for more than half an hour" and "Pain prevents me from sitting for more than 1 hour." This implies that typical patients who underwent lumbar spinal fusion will sit in a chair for more than 1 hour, sometimes as long as they want if they sit on a proper chair, but, on the floor, they can sit more than 30 minutes but not more than 1 hour. In other words, the average patient who had lumbar spinal fusion will not tolerate more than 1 hour of a social gathering or dining in a Korean-style restaurant, and it is possible that this gives them feeling of disability in their personal and social activities.

An interesting finding of the current study is that patients who had fusion at multiple levels did not show a significantly worse disability score for sitting on the floor than did the patients who had single-level fusion. This is contrary to the general expectation that level of disability would increase with the number of levels of fixation. Instead, it implies that regardless of the number of levels of fusion, the fusion itself is the main cause of disability when sitting on the floor. Another finding is that the disability scores for sitting on the floor were not different among groups who had the fusion at L4-L5 or at L5-S1. Bae et al[28] described in a radiological study of a healthy population on the change of segmental and whole lumbar lordosis according to the postures of standing, sitting in a

Table 5. Comparison of postoperative Oswestry Disability Index (ODI) scores between fusion at L4-L5 and L5-S1 in single-level fusion.

Location (n = 64)	Postoperative ODI With "Sitting in a Chair"	Postoperative ODI With "Sitting on the Floor"	*P* Value
L4-L5 (n = 36)	29.42 ± 16.73	33.45 ± 16.76	.002[a]
L5-S1 (n = 28)	27.96 ± 16.50	31.05 ± 16.62	.02[a]
P Value	.728[b]	.570[b]	

[a]Paired samples *t* test.
[b]Independent samples *t* test.

chair, and sitting on the floor in "oriental style" that 66.2% of the loss of the whole lumbar lordosis during the postural change from sitting in a chair to sitting on the floor occurs at L4-L5, whereas only 6.9% at L5-S1. It was expected that back pain while sitting on the floor after lumbar fusion would be most serious when the fusion is done at the L4-L5 level. However, our data document that there is no difference between fusion at L4-5 or L5-S1 in terms of disability. This supports the concept that a single-level fusion is sufficient to severely limit patients when sitting on the floor regardless of the location of the fusion.

Though there are some limitations such as a retrospective study design, heterogeneous patient group, and different types of surgical method, from the current study, it is evident that true disability after lumbar spinal fusion in the Korean population has not been properly evaluated. This would be true in all societies in which people have style of sitting similar to that of the Korean people, such as Japan and many Middle Eastern countries. We believe those countries need to develop outcome measures that reflect their particular lifestyle or at least modify preexisting ones, such as the modified ODI used in current study, to accurately measure an important disability in daily activities in their societies. In addition, when spinal arthrodesis is planned as a treatment option, the cultural lifestyle of a patient should be seriously considered and the postoperative limitation in terms of sitting on the floor should be fully discussed with the patients in a preoperative consultation. Patients should adequately be informed that a consequence of the surgery helpful in treating their back and leg pain may be severe limitation of their ability to sit in their traditional style.

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