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CASE SERIES

Return to work after adult spinal deformity surgery

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Abstract

Purpose To determine the proportions of patients returning to work at various points after adult spinal deformity (ASD) surgery and the associations between surgical invasiveness and time to return to work.

Methods Using a multicenter database of patients treated surgically for ASD from 2008 to 2015, we identified 188 patients (mean age 51 ± 15 years) who self-reported as employed preoperatively and had 2-year follow-up. Per the ASD–Surgical and Radiographical Invasiveness Index (ASD–SR), 118 patients (63%) underwent high-invasiveness (HI) surgery (ASD–SR $\geq$ 100) and 70 (37%) had low-invasiveness (LI) surgery (ASD–SR < 100). Patients who self-reported $\geq$ 75% normal level of work/school activity were considered to be working *full time*. Chi-squared and Fisher exact tests were used to compare categorical variables ($\alpha = .05$).

Results Preoperatively, 69% of employed patients worked full time. Postoperatively, 15% of employed patients were full time at 6 weeks, 70% at 6 months, 83% at 1 year, and 84% at 2 years. Percentage of employed patients working full time at 2 years was greater than preoperatively ($p < .001$); percentage of patients returning to full time at 6 weeks was lower in the HI (5%) than in the LI group (19%) ($p = .03$), a difference not significant at later points.

Conclusions Most adults returned to full-time work after ASD surgery. A smaller percentage of patients in the HI group than in the LI group returned to full-time work at 6 weeks. Patients employed full time preoperatively will likely return to full-time employment after ASD surgery.

Level of evidence: III.

Keywords Adult spinal deformity · Adult Spinal Deformity Surgical and Radiographical Invasiveness Index · Employment · Return to work · Surgical invasiveness

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Introduction

After undergoing surgery to treat adult spinal deformity (ASD), patients face a challenging recovery in terms of regaining functional abilities and alleviating pain [1, 2]. Although studies [3, 4] have reported a high risk of complications after ASD surgery, ranging from 14 to 70%, ASD surgery is associated with significant improvements in health-related quality of life [3, 5].

For ASD patients who are employed full time, returning to full-time work after surgery is an important postoperative outcome. Surgical correction of ASD is associated with a high economic burden [6, 7], and patients may incur additional burden if they are unable to work postoperatively [2, 7]. One of the most consistent predictors of returning to work for patients undergoing spine surgery is their recovery expectations. Unrealistic expectations of surgical outcomes are associated with worse patient satisfaction, rehabilitation compliance, and overall recovery [8]. Therefore, it is necessary for patients and providers to have realistic expectations for returning to work after surgery. Several studies have investigated returning to work after cervical and lumbar surgery [9–11]; however, we are unaware of any studies analyzing postoperative return to work exclusively in ASD patients.

Our goals were to determine 1) the proportions of patients who returned to full-time work at various points after ASD surgery; and 2) how surgical invasiveness is associated with time until return to full-time work. Patients who self-reported ≥ 75% normal level of work/school activity were considered to be working *full time*. We hypothesized that ASD surgery would not limit the ability of employed ASD patients to return to full-time work, and that greater surgical invasiveness would be associated with delayed return to work.

Methods

Institutional review board approval was obtained from all participating study sites.

Patient population

We analyzed records from a multicenter, prospective, surgeon-maintained registry of ASD patients who were enrolled from January 1, 2008, through September 23, 2015. Criteria for inclusion included arthrodesis of more than 5 spinal levels and any one of the following: diagnosis of adult degenerative or idiopathic scoliosis with a spinal curve ≥ 20°; sagittal vertical axis > 5 cm; pelvic tilt > 25°; or thoracic kyphosis > 60°. We excluded patients with a diagnosis other than degenerative or idiopathic scoliosis, those younger than 18 years, and those who had undergone previous scoliosis surgery.

Our data set included 255 ASD patients who were employed preoperatively and who were eligible for 2-year follow-up. Of these patients, 188 (79% women) had 2-year follow-up. The designation of employment (i.e., employed, unemployed, retired) was made according to a preoperative questionnaire given to patients with a survey question directly assessing employment. The numeric rating scale (NRS) was used to evaluate and report back pain. This scale is a self-reported, interval score ranging from 0 to 10, with 0 indicating no back pain and 10 indicating the worst back pain imaginable [12]. The Scoliosis Research Society 22r (SRS-22r) questionnaire was used to evaluate and report health-related quality-of-life domains. This questionnaire consists of 22 questions assessing health-related quality of life across 5 domains: function, pain, mental health, self-image, and satisfaction. Each domain is scored from 1 to 5, with higher scores indicating better outcomes. The SRS-22r is used widely to assess outcomes in ASD patients and has been shown to be valid, reliable, and responsive in this population [13, 14].

Surgical invasiveness

Surgical invasiveness was measured using the ASD–Surgical and Radiographical (ASD–SR) index [15]. This surgical invasiveness index was developed by Neuman et al. [15] specifically for use in the ASD population and has been used in spine deformity research [16]. The index incorporates predictors of operative time and estimated blood loss. The components that constitute the ASD–SR index are the number of levels fused, number of levels decompressed, number of osteotomies, type of osteotomy, presence and type of interbody fusion, presence of iliac fixation, and whether the surgery was a revision surgery (Table 1) [15]. One hundred eighteen patients (63%) were categorized as having undergone surgery with high invasiveness (HI) (ASD–SR value ≥ 100), and 70 patients (37%) were categorized as having undergone surgery with low invasiveness (LI) (ASD–SR value < 100).

Outcome

A given patient's level of employment (part-time or full-time) was determined using the SRS-22r patient questionnaire, which asks, "What is your current level of work/school activity?" Response options are 0% of normal, 25% of normal, 50% of normal, 75% of normal, or 100% of normal. Full-time employment was a binary measure defined as reporting 75–100% of normal work/school activity.

Table 1 Scoring of the adult spinal deformity–surgical and radiographical invasiveness index

Variable	Points
Surgical variable	
Posterior	
Decompression	1 per vertebra
Fusion	2 per vertebra
Osteotomy	1 per vertebra
3-Column	14 per osteotomy
Smith–Petersen	1 per osteotomy
Interbody fusion	
Anterior lumbar	8 per interbody fusion
Transforaminal/posterior lumbar	2 per interbody fusion
Iliac fixation	2
Revision surgery	3
Radiographic variables	
PI − LL	0.5 per 1° change
Pelvic tilt	2 per 1° change
Sagittal vertical axis	0.2 per 1-cm change
Thoracic kyphosis	0.5 per 1° change

PI−LL pelvic incidence minus lumbar lordosis

Table 2 Preoperative demographic characteristics of 188 employed patients who underwent adult spinal deformity surgery from 2008 to 2015, with 2-year follow-up

Characteristic	*N* (%)	Mean ± SD
Patient and surgical		
Age, years		51 ± 15
Female sex	148 (79)	
Previous spine surgery	62 (33)	
3-Column osteotomy	26 (14)	
Estimated blood loss, L		1.5 ± 1.4
Health-related quality of life[a]		
NRS for back pain		6.6 ± 2.4
SRS-22r total score		3.1 ± 0.6
SRS-22r function		3.4 ± 0.78
SRS-22r mental health		3.7 ± 0.78
SRS-22r pain		2.8 ± 0.8
SRS-22r self-image		2.6 ± 0.7
Radiographic		
Pelvic tilt, °		22 ± 11
PI-LL, °		12 ± 21
Sacral slope, °		32 ± 13
Sagittal vertical axis, cm		4.0 ± 6.2
Thoracic kyphosis, °		15 ± 1.0

NRS numeric rating scale, *PI−LL* pelvic incidence minus lumbar lordosis, *SD* standard deviation, *SRS-22r* Scoliosis Research Society-22r patient questionnaire

[a]The NRS ranges from 0 to 10, with 0 indicating no pain and 10 indicating the worst possible pain; SRS-22r total and sub-domains were scored from 1 to 5, with 1 indicating the worst score and 5 indicating the best score

Full-time work status was measured preoperatively and at 6 weeks, 6 months, 1 year, and 2 years postoperatively.

Statistical analysis

Chi-squared and Fisher exact tests were used to compare the distributions of categorical variables. Significance was set at $p < .05$. All statistical analyses were performed using Stata Statistical Software: Release 15 (StataCorp LLC; College Station, TX).

Results

Study cohort

The mean (± standard deviation) patient age was 51 ± 15 years. Twenty-six patients (14%) underwent 3-column osteotomy. Overall, 34% of patients had undergone previous spine surgeries. Patients had mean estimated blood loss of 1.5 ± 1.4 L, indicating high surgical invasiveness (Table 2). The mean score on the numeric rating scale for back pain was 6.6 ± 2.4. The mean (± standard deviation) SRS-22r total score was 3.1 ± 0.6. Mean domain scores were as follows: activity, 3.4 ± 0.78; mental health, 3.7 ± 0.78; pain, 2.8 ± 0.8; and self-image, 2.6 ± 0.7.

Return to work

Of the patients in our cohort who were employed preoperatively, 69% were working full time before surgery. In other words, 69% of the patients in our cohort—all of whom were employed preoperatively—were categorized as working full time according to their response to question 9 of the SRS-22r questionnaire. Postoperatively, 15% of employed patients were working full time at 6 weeks, 70% at 6 months, 83% at 1 year, and 84% at 2 years (Fig. 1). Compared with before surgery, the percentage of patients working full time was significantly greater at 2 years postoperatively (84% vs. 69% $p < .001$).

The percentage of patients returning to work full time at 6 weeks postoperatively was significantly smaller in the HI group (5%) than in the LI group (19%) ($p = .03$); however, this difference was not significant at 6 months, 1 year, and 2 years postoperatively (Fig. 1).

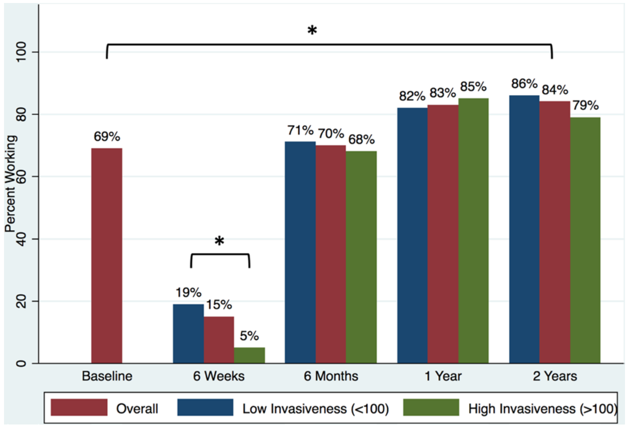

Fig. 1 Percentage of employed patients, stratified by surgical invasiveness, who returned to full-time work after adult spinal deformity surgery (*N* = 188). Surgical invasiveness was measured using the ASD–SR. Patients were categorized into the following two groups: high invasiveness (ASD–SR value ≥ 100) or low invasiveness (ASD–SR value < 100). *Denotes statistical significance. *ASD–SR* Adult Spinal Deformity–Surgical and Radiographical Invasiveness Index

Return to work by surgical invasiveness

When comparing the LI and HI groups, the patients in the HI group were significantly older (mean, 56 ± 1.3 years vs. 47 ± 1.5 years, $p = .002$) and comprised a higher proportion of patients with 3-column osteotomies (28% vs. 7.6%, $p < .001$). In addition, patients in the HI group had significantly greater estimated blood loss (mean, 2.1 ± 1.8 L vs. 1.3 ± 1.2 L, $p = .002$) and worse preoperative SRS 22-r function, pain, self-image, and total scores (all, $p < .05$). Moreover, the patients in the HI group also had greater pelvic tilt, pelvic incidence minus lumbar lordosis (PI-LL), and sagittal vertical axis, and less sacral slope (all, $p < .05$). Comparisons of preoperative values between LI and HI groups are shown in Table 3. Comparisons of preoperative and postoperative spinopelvic parameters are shown in Table 4.

Table 3 Preoperative demographic characteristics compared between low-invasiveness ($n = 117$) and high invasiveness ($n = 61$) groups

Characteristic	Low invasiveness (Mean 69, Range 16–99.9)		High invasiveness (Mean 124, Range 100–171)		p^*
	n (%)	Mean ± SD	*n* (%)	Mean ± SD	
Patient and surgical					
Age, years		47 ± 1.5		56 ± 1.3	0.002
Female sex	94 (80)		54 (89)		0.234
Previous spine surgery	37 (31)		25 (41)		0.225
3-Column osteotomy	9 (7.6)		17 (28)		< 0.001
Estimated blood loss, L		1.3 ± 1.2		2.1 ± 1.8	0.002
Health-related quality of life[a]					
NRS for back pain		6.5 ± 0.2		6.9 ± 2.2	0.277
SRS-22r total score		3.2 ± 0.5		2.9 ± 0.5	0.003
SRS-22r function		3.6 ± 0.1		3.1 ± 0.1	< 0.001
SRS-22r mental health		3.7 ± 0.8		3.7 ± 0.1	0.889
SRS-22r pain		2.9 ± 0.8		2.6 ± 0.8	0.028
SRS-22r self-image		2.8 ± 0.7		2.4 ± 0.1	0.004
Radiographic					
Pelvic tilt, °		19 ± 11		26 ± 11	< 0.001
PI-LL, °		5.7 ± 19		21 ± 21	< 0.001
Sacral slope, °		35 ± 13		27 ± 11	< 0.001
Sagittal vertical axis, cm		2.3 ± 4.7		6.7 ± 8.7	< 0.001
Thoracic kyphosis, °		15 ± 0.9		15 ± 1.1	0.850
No. of levels fused		9.8 ± 3.7		14.1 ± 3.2	< 0.001

NRS numeric rating scale, *PI-LL* pelvic incidence minus lumbar lordosis, *SD* standard deviation, *SRS-22r* Scoliosis Research Society-22r patient questionnaire

[a]The NRS ranges from 0 to10, with 0 indicating no pain and 10 indicating the worst possible pain; SRS-22r total and sub-domains were scored from 1 to 5, with 1 indicating the worst score and 5 indicating the best score

*From Student *t* test for continuous variables and chi^2 test for categorical variables

Table 4 Preoperative and postoperative spinopelvic parameters

Characteristic	Mean ± SD		*p*
	Preoperative	Postoperative	
Pelvic tilt, °	22 ± 11	20 ± 0.85	0.007
PI-LL, °	12 ± 21	2.2 ± 16	< 0.001
Sacral slope, °	32 ± 13	34 ± 0.86	0.0003
Sagittal vertical axis, cm	4.0 ± 6.2	1.6 ± 3.9	< 0.001
Thoracic kyphosis, °	15 ± 1.0	15 ± 0.7	0.47

PI−LL pelvic incidence minus lumbar lordosis, *SD* standard deviation

Discussion

In our study, the percentage of patients who returned to work postoperatively progressively increased at each postoperative interval, with more patients working full time at 2 years after surgery compared with before surgery. Notably, the most substantial increase in the return-to-work rate occurred between the 6-week and 6-month time points. Compared with patients who underwent HI procedures, more patients who underwent LI procedures returned to work full time at 6 weeks postoperatively, though this difference was not significant at later follow-up points. These findings can help ASD patients and their surgeons to set evidence-based expectations about returning to work after surgery.

Previous studies have analyzed return-to-work status after surgery for spinal abnormalities other than ASD and reported varied results. Kim et al. [9] reported that 83% (269/324) of employed patients returned to work within 3 months after elective surgery for degenerative cervical disease, with a mean return-to-work time of 35 days. Truszczyńska et al. [17] reported that 24% (14/58) of patients returned to work within 6 months after lumbar spinal stenosis surgery; the remaining patients did not return at all within the 8-month follow-up period. Reported return-to-work rates for patients who underwent instrumented surgery for lumbar radiculopathy are 46% at 24 months [18] to 90% at 36 months [19]. Many factors affect returning to work after spine surgery in patients who were employed full time preoperatively. For patients who underwent surgery for spinal stenosis, not returning to work was associated with female sex, low educational level, and low income [17]. For patients who underwent elective cervical spine surgery, not returning to work was associated with a labor-intensive occupation, high American Society of Anesthesiology classification score, history of coronary artery disease, and history of chronic obstructive pulmonary disease [9]. Other studies have shown that patient characteristics (e.g., sex, age, and comorbidities), less invasive surgery, preoperative job function, strenuousness of the job, and duration of preoperative sick leave are all independent predictors of delayed return to work after spine surgery [11, 20–23]. It should also be mentioned that, although patients have a favorable rate of returning to work after ASD surgery, it has been previously shown that activities of daily living such as wiping the floor, picking up objects, and sitting cross-legged may be impaired after long spinal fusions [24].

The second purpose of our study was to determine how the level of surgical invasiveness was associated with return-to-work rates in the ASD population. We found that the LI group had a significantly higher return-to-work rate than the HI group at 6 weeks postoperatively, but this difference was nonsignificant at 6 months, 1 year, and 2 years postoperatively. Put differently, low-invasive ASD surgery was associated with earlier return to work at 6 weeks, but was not associated with the overall percentage of patients who returned to work at later time points. These findings are consistent with studies that have reported less invasive spine surgery as a predictive factor for earlier return to work [25–29]. Furthermore, this temporal association between less invasive ASD surgery and earlier return to work was consistent with the findings of Lv et al. [19], who reported a mean duration of sick leave of 5.2 weeks after low-invasive vs. 7.3 weeks after conventional lumbar arthrodesis.

Our results raise an important question: What other factors may influence return to work after ASD surgery? For example, the type and intensity of postoperative rehabilitation are known to affect the timeline for returning to work after ASD surgery. Sjolinder and Nota [30] reported that of 38 patients who underwent cervical or lumbar procedures, 10 patients returned to their former occupations after an aggressive rehabilitation program initiated 1 day after surgery. The mean duration of the rehabilitation program was 15.3 days for these patients, and patients returned to their preoperative occupations at a mean 19.7 days after surgery [30]. The program included individualized education, as well as water-based, resistance, and aerobic exercises targeting stabilization and flexibility. A similar aggressive rehabilitation program started early after ASD surgery may be beneficial for ASD patients who want to return to work sooner.

Several important limitations of our study should be discussed. First, although our data were collected prospectively, our study design was retrospective. As such, our results are subject to biases inherent to retrospective studies, such as recall bias, in which patients reporting full-time preoperative employment may have actually been working part-time preoperatively. This bias would potentially underestimate the beneficial effects of their surgery. In addition, the level of employment (full-time or part-time) was assessed using a question in the SRS-22r questionnaire. Although this question asks about current employment status, it is part of a larger questionnaire that was not designed specifically to evaluate employment status and does not differentiate between types of employment (e.g., desk or manual labor job). In future prospective studies of this topic, it would be helpful to ask additional questions that more comprehensively assess a patient's employment or lack of current employment (e.g., timeframe, reasons for unemployment, expected re-employment date). We also believe that the external validity of our study may potentially be limited because of cultural differences in lifestyle and work-related expectations among patients from different regions of the world. In addition, we recognize that work may be limited by other orthopaedic conditions not assessed by our study, such as knee osteoarthritis or cardiac or pulmonary conditions.

Our study is also limited by the fact that patients who had filed workers' compensation claims and/or were on disability leave were not sub-analyzed within our cohort. Although patients may or may not have had work-related spine conditions, it is known that workers' compensation cases are associated with worse patient-reported outcomes and lower rates of resuming postoperative work after elective spine surgery relative to non-workers' compensation cases [9, 31, 32]. In theory, patients unable to obtain workers' compensation may be forced to return to work despite being physically or mentally unready to resume their preoperative work activities [11]. Similarly, patients with disability claims may have a different timeline for returning to work because of the severity of their condition or differences in motivation to regain employment postoperatively. The applicability of this theory to ASD patients was not assessed in our study. Finally, while we examined the association between surgical invasiveness as a dichotomous variable (low vs. high invasiveness) and return to work, it would also be interesting to devise a study which explores the relationship between continuous variables, such as spinopelvic parameters and returning to work. This was outside the original hypothesis of the present study but merits future investigation.

Conclusions

The proportion of ASD patients who were working full time at 2 years after ASD surgery was significantly higher than before surgery. Patients who underwent less invasive ASD surgery returned to work earlier than patients underwent more invasive surgery. Expectations for return to work after spine surgery are paramount for patient satisfaction and overall recovery; therefore, our findings are critical for shared decision-making between ASD patients and their providers.

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Declarations

Conflict of interest All authors declare that they have no conflicts of interest.

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