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DEFORMITY

Timing and Predictors of Return to Short-term Functional Activity in Adolescent Idiopathic Scoliosis After Posterior Spinal Fusion

A Prospective Study

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Study Design. Prospective study.

Objective. To assess the timing and predictors of return to short-term functional activity in patients with adolescent idiopathic scoliosis (AIS) after posterior spinal fusion (PSF).

Summary of Background Data. Few studies have examined the timing and rate of return to short-term functional activity in patients with AIS after PSF. No study has yet evaluated the timing and factors that predict a delayed return to school/college—a topic relevant to patients who have had or anticipate having spinal fusion, and their treating surgeons.

Methods. Seventy-seven eligible subjects with AIS who underwent PSF and correction (January 2010 to April 2012) were followed up until return to the functional outcomes under analysis. Timing of return to school/college and physical activity, as per the patients' preoperative level or better, was assessed. Binary logistic regression analysis was used to determine predictors of delayed return to school/college full-time (>16 wk) and unrestricted physical activity (>32 wk) relative to sociodemographic, anthropometric, radiographical, clinical, and surgical factors. In the present study, a "delayed" return to all the functional outcomes recorded was defined as "greater than the 75th percentile" of the continuous distribution.

Results. Mean follow-up was 12.8 months (SD, 5.7). Mean age was 15.04 years (SD, 1.89). The median time to return to school/college full-time (n = 75) was 10 weeks; the majority returned by 16 weeks (77.3%). Preoperative curves greater than 70° (relative risk, 3.38; $P = 0.008$), postoperative weight loss greater than 5 kg (relative risk, 3.02; $P = 0.012$), and minor perioperative respiratory complication incidence (relative risk, 2.89; $P = 0.024$) independently predicted delayed return to school/college full-time. By 24 and 52 weeks, 51.4% and 88.5% of subjects, respectively, returned to unrestricted physical activity. At final follow-up, nonreturn to unrestricted physical activity was identified in only 3 subjects (4.3%) because of chronic back pain.

Conclusion. The majority of patients with AIS can expect to return to school/college full-time by 16 weeks and unrestricted physical activity by 52 weeks after PSF. Preoperative curves greater than 70°, postoperative weight loss greater than 5 kg, and minor perioperative respiratory complication incidence independently predicted a delayed return to school/college full-time. These findings add to the current knowledge base regarding actual *versus* anticipated timing of return to short-term functional outcomes in this population.

Key words: adolescent idiopathic scoliosis, posterior spinal fusion, functional outcomes, return to physical activity; return to school/college, prospective study.

Level of Evidence: 3

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Adolescent idiopathic scoliosis (AIS) is a 3-dimensional deformity of the spine, diagnosed in 2% to 3% of the adolescent population.[1,2] When conservative treatment measures fail, surgery is necessary to halt curve progression, correct the deformity, and maintain a balanced spine with the least number of vertebral levels fused.[3,4] The impact of spine surgery on school attendance and return to daily activities, such as sports, has been identified as particular queries

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from patients with AIS.[5] However, few reports have examined the actual timing and return rates to short-term function in this patient group. Given that most patients with AIS attend school/college, and that exercise and athletic competition for young individuals have become increasingly important in society,[6] evaluating return to such functional outcomes after spinal fusion is a relevant aspect of their recovery that warrants further study.

A formal consensus or position statement regarding the recommended time to return to sporting activity after corrective spine surgery for AIS is lacking. Existing guidelines are derived from expert opinion, and the opinion of the attending surgeon,[7] which has been shown to vary widely.[8,9] A survey by Rubery and Bradford[8] (n = 261) demonstrated that 43% of surgeons allowed their patients to resume low-impact noncontact sports such as swimming at 6 months, whereas the majority returned their patients to gym class between 6 months and 1 year. Other surgeons suggest that patients with AIS should be allowed to return to noncontact and contact sport within 3 to 6 months of surgery.[9] Online guidance regarding expected postoperative return to functional activities in patients with AIS is also available. The Scoliosis Research Society[10] suggests that patients can perform regular daily activities and generally return to school in 3 to 4 weeks, and depending on the activities of the patient, full participation is allowed between 3 and 6 months after surgery. According to the Scoliosis Association UK,[11] case-dependent patients can expect to return to work or near normal activities by around 14 to 16 weeks.

Despite these guidelines, very little is known about the actual time of return to short-term function in patients with AIS after spinal fusion and what factors predict a poor outcome. Previous evaluations have been either retrospective[12] or long-term follow-up[13–17] studies, with findings often based on validated scoliosis outcome instruments.[13,18,19] The aim of the present study was to prospectively assess actual timing of return to school/college and physical activity in subjects with AIS after posterior spinal fusion (PSF) and examine the factors that predict delayed return to these functional outcomes.

MATERIALS AND METHODS

Study Design and Patient Selection

All eligible patients with AIS, who underwent PSF and deformity correction at 2 Dublin tertiary pediatric centers (Our Lady's Children's Hospital, Crumlin, and the Blackrock Clinic) from January 2010 to April 2012, were prospectively followed up until they reported a return to all the short-term functional outcomes under analysis. Ethical approval was obtained from the hospitals' ethics committees prior to study commencement, and verbal informed consent to participate was obtained either from the patient or the parent (for patients younger than 16 yr).

Inclusion criteria included a diagnosis of AIS, treatment with 1-stage PSF, and ambulatory status. Exclusion criteria included a history of spinal surgery, preoperative artificial feeding, congenital abnormalities, and other complex comorbidities, namely, neurological, cardiac, metabolic, endocrine, and psychiatric disorders. From the 78 consecutive patients with AIS who underwent spinal fusion during the study period, 1 case was excluded because of a diagnosis of hypothyroidism; all the remaining 77 cases participated and were successfully followed up.

Explanatory and Independent Variables

Baseline sociodemographic data (age at surgery, sex, race), preoperative comorbidities, intrasurgical factors (surgical duration, estimated blood loss), length of hospital stay, perioperative (*i.e.*, intra and post) complications, as well as hospital readmission incidence were collected. The definition of a perioperative complication in the current study was broad and included adverse events occurring within 30 days postsurgery. Preoperative weight (kg), standing height (cm), and, where available, hospital discharge weights were recorded; weight loss during the hospital stay and corrected body mass index were computed. Immediate pre and postoperative radiographs were measured using the Cobb method.

Outcome Measures

The primary outcome assessed in this study was return to functional activities after surgery. This was assessed on the basis of timing to return to school/college and physical activity. Timing to return to school/college was dichotomized as part-time (*i.e.*, half days) and full-time (*i.e.*, full days). Return to physical activity "as per the patient's preoperative level or better" was dichotomized as (1) "part-time," defined as low-impact, noncontact, noncompetitive recreational physical activity greater than walking including gentle swimming, yoga, Pilates, jogging, and cycling, and (2) "unrestricted" physical activity including competitive athletic activity and contact sports.

The secondary outcomes assessed included reported time to resumption of a normal eating pattern/appetite and sleeping pattern uninterrupted by pain, as per the patient's preoperative habitual pattern, as well as time to achieving preoperative weight.

Follow-up

Follow-up was performed by the study coordinator (R.C.T.) *via* telephone interviews with parents and when indicated, the adolescent, using a structured questionnaire. The first follow-up time point coincided with the 6-week postoperative checkup, with subsequent telephone interviews conducted every 6 to 8 weeks, until return to all functional outcomes was reported. At each follow-up time point, patients were asked to report the specific date they returned to each functional outcome under study, if applicable; the specific date of their timing of return was then documented. For instance, if patients were contacted at 14 weeks after surgery, and they reported return to part-time physical activity at 10 weeks, then their timing of return to this functional outcome was documented as 10 weeks. If nonreturn to any of the functional outcomes under analysis was reported during the first year after surgery, subjects were followed up to a minimum of 18 months and thereafter. The authors were prepared to follow up patients to 2 years, if required.

Time to achieving functional outcomes was calculated from postoperative day 1. In the present study, a "delayed" return to all the functional outcomes recorded was defined as "greater than the 75th percentile" of the continuous distribution.

Statistical Methods

Data were analyzed using Statistical Package for the Social Sciences Version 19.0 (SPSS, Inc., Chicago, IL). Data are presented using numerical descriptive statistics, including means with standard deviations (SD) or medians with interquartile ranges (IQR), as appropriate. Binary logistic regression analysis was used to determine the variables that independently predicted delayed return to school/college full-time (*i.e.*, using the 75th percentile as a cutoff, equivalent to "> 16 wk") as well as delayed return to unrestricted physical activity (*i.e.*, using the 75th percentile as a cutoff, equivalent to ">32 wk"). The relative risk (RR) and 95% confidence intervals were calculated for each predictor factor in the final model. Statistical significance was set at *P* value of less than 0.05.

RESULTS

The mean follow-up time for the 77 eligible cases was 12.8 months (SD, 5.7). Patient characteristics are detailed in Table 1. The vast majority of subjects were Caucasian (n = 76; 98.7%). Severe preoperative curves (>70°) were identified in 21 cases (27.3%). Postoperatively, the median thoracic and lumbar curve angles were 17° (IQR, 12–25.7) and 13° (IQR, 8–20), respectively, equivalent to a median percent thoracic and lumbar curve correction of 71.5% (IQR, 61.7–81) and 70.1% (IQR, 58–83.7), respectively.

Return to School/College

Two subjects in the cohort reported nonattendance at school/college preoperatively and were thus excluded from this analysis. Of the remaining 75 subjects, the median time to return on a full-time basis was 10 weeks (IQR, 6–16) (Table 2). By 6, 16, and 24 weeks, 25.3%, 77.3%, and 94.6% of these subjects, respectively, returned to school/college full-time; all subjects returned by 36 weeks.

Twenty cases were excluded from the analysis of part-time return to school/college; these included two cases who reported nonattendance at school/college preoperatively, in addition to 13 cases whose surgeries were performed during the summer holidays and 5 cases who returned to school/college on a full time basis only. By 4 and 8 weeks, 31.6% and 91.2% of subjects, respectively, returned to school part-time; all subjects returned by 20 weeks.

Predictors of Delayed Return to School/College Full-Time (>16 wk)

Factors significantly associated with delayed return to school/college full-time in the univariate analysis are highlighted in Table 3. After adjustment in the multivariate analysis, preoperative curves greater than 70° (RR, 3.38; $P = 0.008$), weight loss greater than 5 kg during the hospital stay (RR, 3.02; $P = 0.012$), and minor perioperative respiratory complication

TABLE 1. Demographic Characteristics and Key Parameters in 77 Patients Who Participated in the Prospective Follow-up

Characteristic	
Age at surgery (yr), mean (SD)	15.04 (1.89)
Female, n (%)	72 (93.5)
Preoperative primary curve Cobb angle (°), mean (SD)	62.3 (13.2)
No. fused vertebrae, median (IQR)	12 (10–13)
Proximal level of fusion, median	T3
Distal level of fusion, median	L3
Surgical duration (hr), median (IQR)	5.5 (4.3–7)
Estimated intraoperative blood loss (mL), median (IQR)	1012 (791–1400)
Overall minor perioperative complication* incidence, n (%)	57 (74)
Gastrointestinal (ileus)	7 (9.1)
Respiratory-related†	16 (20.8)
Electrolyte imbalance	14 (18.2)
Blood product transfusion	36 (46.8)
Superficial wound infection	5 (6.5)
Overall major perioperative complication‡ incidence, n (%)	4 (5.2)
Pneumothorax requiring chest drain insertion	2 (2.6)
SMA syndrome	1 (1.3)
Type 1 respiratory failure	1 (1.3)
Weight on admission (kg), mean (SD)	52 (10.8)
BMI_{corr} at hospital discharge (centile band)§, n (%)	
≤25th	49 (68.1)
>25–75th	11 (15.3)
>75th	12 (16.7)
Weight loss >5 kg during the hospital stay¶, n (%)	21 (29.2)
Postoperative parenteral nutrition received, n (%)	8 (10.4)
Length of hospital stay (d), median (IQR)	10 (8–11)
Hospital readmission incidence, n (%)	3 (3.9)

**Similar to the study by Campbell et al[20], minor complications included all events with transient detrimental effect including medical adverse events or surgical complications with limited need for further intervention.*

†Includes pneumonia (n = 5) ± pleural effusion (n = 11) ± atelectasis (n = 4) ± lower respiratory tract infection (n = 1).

‡Major complications included adverse events necessitating a longer hospital/intensive care stay, requiring further significant medical and surgical interventions.

§The height loss equation described by Ylikoski[21] was used to calculate corrected height, the values from which were used to compute BMI_{corr} (weight in kilograms/height in meters^2); UK age and sex-specific BMI charts (Cole et al[22]) were used; data available for n = 72 cases.

¶Cutoff value of "5 kg" weight loss (equivalent to 10% weight loss in the sample), corresponds to the 75th percentile of the continuous variable; data available for n = 72 cases.

IQR indicates interquartile range; SMA, superior mesenteric artery; BMI_{corr}, corrected body mass index.

TABLE 2. Return to School/College and Physical Activity Statistics

	School/College Return (wk)		Physical Activity (wk)	
	Part-time*	Full-time†	Part-time‡	Unrestricted§
Statistic	n = 57	n = 75	n = 74	n = 70
Median	6	10	11.5	24
25th percentile	4	6	6	16
75th percentile	6.4	16	16	32

**Defined as half days; n = 20 excluded cases (for details on exclusions, refer to "Results" section).*

†Defined as full days; n = 2 excluded cases who did not attend school/college preoperatively.

‡Includes low-impact, noncontact, noncompetitive recreational physical activity greater than walking, as per the patient's preoperative level or better, including gentle swimming, jogging, cycling, yoga, Pilates; n = 3 excluded subjects who never participated in part-time physical activity preoperatively.

§Includes contact sports and competitive athletic activity, as per the patient's preoperative level or better; n = 7 excluded cases who never participated in unrestricted or "any" physical activity greater than walking preoperatively; of the 70 eligible cases, there were n = 3 missing values of those who did not return to unrestricted physical activity during the study.

incidence (RR, 2.89; $P = 0.024$) independently predicted delayed return to school/college full-time (Table 4).

Return to Physical Activity

Nonparticipation in unrestricted (n = 4) or "any" physical activity greater than walking (n = 3) preoperatively was reported by 7 subjects, whom were excluded from this analysis. Of the remaining 70 cases, 95.7% (n = 67) returned to unrestricted physical activity by 18 months. "Chronic back pain" was the main barrier to returning to unrestricted physical activity in 3 cases (4.3%) followed up to 21, 24, and 29 months, respectively.

By 24 and 52 weeks, 51.4% (n = 36) and 88.5% (n = 62) of subjects, respectively, had returned to unrestricted physical activity.

Predictors of Delayed Return to Unrestricted Physical Activity (>32 wk)

The factors, delayed return to part-time physical activity and school full-time, were associated with a significant delay in return to unrestricted physical activity in the univariate analysis (Table 3), and the strength of their effect persisted in the final multivariate model after adjustment (delayed return to part-time physical activity: RR, 4.12; $P = 0.036$; delayed return to school/college full-time: RR, 5.3; $P = 0.002$). Perioperative clinical factors were not independently predictive of delayed return to unrestricted physical activity.

Preoperative comorbidities, intrasurgical variables, hospital readmission incidence, percent curve correction, and level of fusion did not significantly influence either delayed return to school/college full-time or unrestricted physical activity.

Descriptive statistics with regard to return to self-reported preoperative weight, a normal eating and sleeping pattern, are summarized in Table 5. By 6 weeks, the majority of subjects were eating (75.3%) and sleeping (85.5%) as per their preoperative habitual pattern.

DISCUSSION

To the current investigators' knowledge, this is the first study to prospectively assess actual timing of return to short-term functional outcomes in patients with AIS after PSF, thus comparability of the findings with existing data is limited. Return to school part-time and full-time at the current authors' institutions is recommended at 4 weeks and 6 weeks, respectively—-a guideline that is generally consistent with online anticipatory guidance regarding return to school after corrective spine surgery for AIS, on professional Web sites.[10,23] As part of the routine hospital discharge information, all patients are informed of the recommended timing of return to both school (part-time and full-time) and physical activity (part-time and unrestricted) by the spinal disorders nurse specialist, nursing staff, physiotherapist, and treating surgeons. In addition, all patients are provided with an information leaflet detailing these post–spinal fusion recommendations. According to the current study, however, subjects with AIS returned to school/college part-time and full-time, later than recommended, on average at 6 weeks and 10 weeks post-PSF, respectively. In fact, by 6 weeks, only a quarter of the sample had returned full-time (25.3%). It is unknown from this study whether patients were genuinely physically incapable of returning to school/college earlier, as recommended, or whether there was an element of intentional delay in returning, in spite of their true capability. It may be that existing guidelines regarding time to return to school after spinal fusion are overly optimistic relative to patients' postoperative limitations. Nonetheless, these findings demonstrate that the actual time of return to school/college in patients with AIS post-PSF is later than is widely anticipated.

Postoperative weight loss of more than 5 kg was independently predictive of delayed return to school/college full-time in this study. Low body mass index in patients with AIS has been associated with increased postoperative risks for ileus[24] and acute pancreatitis[25]; significant postoperative weight loss has been associated with increased risks for superior mesenteric

TABLE 3. Univariate Analysis of the Factors Associated With Return to School/College Full-Time and Unrestricted Physical Activity

Factor	Delayed Return To School/College Full-Time (>16 wk)* n = 17	NonDelayed Return to School/College Full-Time (≤16 wk)* n = 58	Delayed Return to Unrestricted PA (> 32 wk)† n = 15	Nondelayed Return to Unrestricted PA (≤ 32 wk)† n = 52
Age at surgery (yr), n (%)				
≤16	12 (70.6)	39 (67.2)	11 (73.3)	37 (71.2)
>16	5 (29.4)	19 (32.8)	4 (26.7)	15 (28.8)
Preoperative curve severity (°), n (%)				
≤70	10 (58.8)	45 (77.6)	9 (60)	39 (75)
>70	7 (41.2)‡	13 (22.4)	6 (40)	13 (25)
Minor perioperative respiratory complications§, n (%)	7 (41.2)‡	9 (15.5)	5 (33.3)	8 (15.4)
Overall major complication, n (%)	3 (17.6)‡	1 (1.7)	3 (20)‡	1 (1.9)
Pneumothorax, n (%)	2 (11.8)‡	0	2 (13.3)‡	0
Length of hospital stay (d), n (%)				
≤11	10 (58.8)	52 (89.7)	9 (60)	49 (94.2)
>11	7 (41.2)‡	6 (10.3)	6 (40)¶	3 (5.8)
Weight loss during the hospital stay (kg), n (%)				
≤5	8 (47.1)	42 (79.2)	9 (60)	38 (79.2)
>5	9 (52.9)‡	11 (20.8)	6 (40)	10 (20.8)
Delayed return to part-time physical activity‖, (wk), n (%)	n = 17	n = 55	n = 15	n = 52
≤16	11 (64.7)	46 (83.6)	8 (53.3)	47 (90.4)
>16	6 (35.3)	9 (16.4)	7 (46.7)¶	5 (9.6)
Delayed return to unrestricted physical activity‖, (wk), n (%)	n = 16	n = 49		
≤32	6 (37.5)	44 (89.8)	N/A	N/A
>32	10 (62.5)**	5 (10.2)		
Delayed return to school/college full-time‖ (wk), n (%)			n = 15	n = 50
≤16	N/A	N/A	5 (33.3)	44 (88)
>16			10 (66.7)**	6 (12)
Delayed resumption of a normal eating pattern/appetite, as per the preoperative habitual pattern‖ (wk), n (%)				
≤7	8 (47.1)	49 (84.5)	10 (66.7)	43 (82.7)
>7	9 (52.9)¶	9 (15.5)	5 (33.3)	9 (17.3)
Delayed return to preoperative weight‖ (wk), n (%)	n = 17	n = 56	n = 15	n = 51
≤24	12 (70.6)	55 (98.2)	12 (80)	47 (92.2)
>24	5 (29.4)¶	1 (1.8)	3 (20)	4 (7.8)

**Chi-squared statistics test was used to analyze the relationship between categorical data of the variable "delayed vs. nondelayed return to school/college full-time"; Fisher exact test was used when the cell count was 5 or less.*

†Chi-squared statistics test was used to analyze the relationship between categorical data of the variable "delayed vs. nondelayed return to unrestricted physical activity"; Fisher exact test was used when the cell count was 5 or less.

‡P < 0.05.

§For details on specific perioperative respiratory complications, refer to Table 1.

¶P < 0.01.

‖"Delayed" return to all the functional outcomes presented was taken as greater than 75th percentile for the continuous distribution of the variable (see "Methods" section).

***P < 0.0001.*

PA, physical activity; N/A, not applicable.

TABLE 4. Relative Risks for Factors Predictive of Delayed Return to School/College Full-Time (> 16 wk) Using Binary Logistic Regression Analysis (n = 75)*

	Multivariate Model†		
Independent Factor	**RR**	**95% CI**	***P***
Preoperative curve severity: >70°	3.38	1.55–4.23	0.008
Weight loss during the hospital stay: >5 kg	3.02	1.37–4.22	0.012
Minor perioperative respiratory complication incidence‡	2.89	0.7–5.03	0.024

**The independent variables were dichotomized as follows: preoperative curve severity (≤70° vs. > 70°); weight loss during the hospital stay (≤ 5 kg vs. > 5 kg) where 5 kg corresponds to the 75th percentile of the continuous weight loss variable (equivalent to 10% weight loss in the sample); and minor perioperative respiratory complications experienced (yes vs. no).*

†The model is adjusted for age at surgery and hospital site.

‡For details on specific perioperative respiratory complications, refer to Table 1.

RR indicates relative risk; CI, confidence interval.

artery syndrome.[26] However, this study provides an evidence base for the adverse effect of postoperative weight loss, more than 5 kg specifically, on functional recovery in this population. Postsurgical strategies that involve mitigating weight loss may have some potential benefit to increasing the rate of return to school/college. It was also found that minor perioperative respiratory complication independently predicted a delayed return to school/college, suggesting a possible role for increased and targeted postoperative support (*e.g.*, more intensive physiotherapy with community follow-up) in this patient group. The fact that pulmonary function tests were not recorded limits further analysis; however, based on these data, evaluating associations between perioperative respiratory complications/pulmonary function and return to short-term functional outcomes may be worthwhile in future studies.

There is no formal consensus on return to sport after spine surgery for AIS, and existing recommendations are variable—often decided by the treating surgeon on the basis of the level of fusion, surgical approach,[9] and sporting activity.[6] At the current authors' institutions, "walking" is the only physical activity recommended during the first 6 weeks after surgery—with a paced walking program prescribed by the physiotherapist prior to hospital discharge (*i.e.*, gradual increased pace, duration, and frequency per walking episode). In addition, all patients are provided with a gentle exercise program by the physiotherapist from postoperative day 3 to 5 and advised to follow this exercise program at home during the first 6 weeks or until return to further activity (exercises focusing on active muscle control and gentle spinal range of movement). Physiotherapy input post–hospital discharge is not routine practice or recommended; only patients who report persistent pain/stiffness at the 6-week checkup are referred to outpatient physiotherapy for flexibility stretches and posture work. Following the 6-week checkup, surgeons recommend a return to low-impact noncontact recreational physical activities greater than walking (*e.g.*, swimming, yoga, Pilates) between 6 weeks and 6 months, as tolerated. Case-dependent, unrestricted physical activity is recommended between 6 and 12 months. Subjects in the current study reported a return to part-time physical activity as per their preoperative level or better, by on average 11.5 weeks, and some subjects returned as early as 6 weeks. These findings suggest a surprisingly high level of capability in these patients regarding reported participation in low-impact noncontact sports during the first 3 months after PSF. Given that more than a quarter of subjects in this series (27.3%) had preoperative curves greater than 70°, a further unexpected finding was the rapid rate of return to unrestricted physical activity, with 51.4% of subjects reporting return by 24 weeks. Moreover, complications associated with return to physical activity were not identified in this study. Debate continues over the recommended time to return to contact and noncontact physical activity in patients with AIS after spinal fusion.[8,9] Based on the current study, however, a large proportion of these patients participate in both noncontact and contact sport during the first 6 months postoperatively, without apparent short-term risk.

By 18 months post-PSF, almost all subjects in this series (95.7%) reported return to unrestricted physical activity as

TABLE 5. Return to Self-Reported Preoperative Weight, a Normal Eating Pattern/Appetite and Sleeping Pattern, as Per the Patient's Preoperative Habitual Pattern

	Time to Achieving Preoperative Weight* (wk)	Time to Resuming a Normal Eating Pattern/Appetite (wk)	Time to Resuming a Normal Sleeping Pattern† (wk)
Statistic	**n = 75**	**n = 77**	**n = 77**
Median	15	3	2
25th percentile	4	1	0.5
75th percentile	24	7	4

**n = 2 subjects intentionally did not want to return to their preoperative weight as they reported to being overweight presurgery.*

†Sleeping pattern "uninterrupted by pain," as per the patient's preoperative habitual pattern; n = 1 missing value of a case who did not return to a normal sleeping pattern during study (follow-up to 21 mo)—"chronic pain" was the reported barrier to sleep.

per their preoperative level or better. In contrast, a retrospective study by Fabricant *et al*,[12] at an average follow-up time of 5.5 years (n = 42), showed that only 59.5% of patients with AIS returned to athletics, at the same level or better, post-PSF; "loss of flexibility" and "back pain" were the most common reasons for decline in level of athletic participation. Only 4.3% of patients in the current study reported failure to return to unrestricted physical activity by 18 months, mainly because of chronic back pain. It is noteworthy that the aforementioned study assessed only subjects with AIS who participated in athletic or physical activity outside of required physical education or gym class, whereas the current study included all subjects with AIS of varying preoperative sporting ability. The adverse effect of a distal level of fusion from T11 to L4 on return to athletics at the same level or higher by patients with AIS is reported.[12] Furthermore, in a long-term study with minimum 5-year follow-up, Parsch *et al*[15] demonstrated a negative correlation between Cobb angle and participation in sports activity in subjects with AIS. However, in the current study, no association between delayed return to unrestricted physical activity and any radiographical factor was found. In fact, a delay in returning to part-time physical activity independently predicted a delayed return to unrestricted physical activity, pointing toward the potential benefit of returning patients to part-time physical activity during the first 16 weeks post-PSF. Considered together, further studies to confirm these findings are needed. Evaluating the effect of "early *versus* delayed" return to physical activity on long-term functional, radiographical, and pain outcomes in this patient group post-PSF may also warrant attention in future studies.

The present study has some limitations. Data on the timing of return to short-term functional outcomes are based on reports and perceptions of patients and their parents, which may have been influenced by recall and subjective bias. However, existing scoliosis outcome questionnaires are similarly reliant on patients' reports. The distinct definitions of part-time and unrestricted physical activity were made clear to patients; however, the varying levels of intensity and frequency of specific sport participation within these categories both pre- and postoperatively were not measured in this study. Psychological factors such as patients' motivation levels and coping ability with recovery, along with pain scores and level of family support, were not considered in this analysis. Finally, the investigators acknowledge that cultural differences may have impacted on the timing of postoperative return to function, as well as length of hospitalization, which can vary widely depending on surgeons' and units' practice, surgical complexity, socioeconomic status, and patients' proximity to the spine surgery center. Future international studies using similar functional outcome measures are needed to confirm our results and provide comparative data, especially with respect to return to school/college and physical activity after spinal fusion. Strong features of this study include its prospective study design, close follow-up time points, and successful follow-up of the entire cohort, which included a relatively homogenous sample of patients with AIS who underwent single-stage correction by PSF.

In conclusion, the majority of patients with AIS can expect to return to school/college full-time by 16 weeks (77.3%) and unrestricted physical activity by 52 weeks (88.5%) after PSF. By 6 weeks, the majority of patients can expect to be eating (75.3%) and sleeping (85.5%) as per their preoperative habitual pattern. Preoperative curves greater than 70°, postoperative weight loss of more than 5 kg, and minor perioperative respiratory complication independently predicted a delayed return to school/college full-time. As comparative data on this research topic are lacking, the degree to which cultural differences impacted on our findings is unknown from this study; future research is needed to confirm our findings. For informed decision making both for surgeons and for patients with AIS who have had or anticipate having PSF, these results are not only valuable but also add to the current knowledge base regarding actual *versus* anticipated timing of return to short-term functional outcomes in this patient population.

➢ Key Points

- ❑ This prospective study involved follow-up of 77 eligible patients with AIS who underwent PSF, until return to functional activity was reported (mean follow-up time: 12.8 mo).
- ❑ The majority of patients (mean age at surgery: 15.04 yr) returned to school/college full-time by 16 weeks (77.3%); all patients returned by 36 weeks. By 24 and 52 weeks, 51.4% and 88.5% of patients, respectively, had returned to unrestricted physical activity. At final follow-up, nonreturn to unrestricted physical activity was identified in only 3 patients (4.3%) because of chronic back pain.
- ❑ This study demonstrated that preoperative curves greater than 70° (RR, 3.38, $P = 0.008$), postoperative weight loss of more than 5 kg (RR, 3.02, $P = 0.012$), and minor perioperative respiratory complication incidence (RR, 2.89, $P = 0.024$) independently predicted a delayed return to school/college full-time.
- ❑ These findings add to the current knowledge base regarding actual *versus* anticipated timing of return to short-term functional outcomes in patients with AIS who undergo PSF. Data on return to physical activity may potentially inform future debate and discussion regarding the establishment of postoperative physical activity guidelines in this patient population.

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