Perioperative Considerations in Patients With Rett Syndrome as Compared With Those With Cerebral Palsy

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Study Design. Retrospective cohort study.

Objective. This study aimed to compare perioperative outcomes of Rett syndrome (RS) and cerebral palsy (CP) patients undergoing posterior spinal fusion for neuromuscular scoliosis.

Summary of Background Data. Surgical correction in the treatment of scoliosis for patients with RS has been shown to increase the survival rate. CP patients, like RS patients, are often nonverbal and nonambulatory, with frequent surgical complications.

Materials and Methods. Retrospective review of 36 RS and 80 CP patients undergoing posterior spinal fusion from 2005 to 2023. Data and x-ray measurements were collected preoperatively and postoperatively. A subanalysis was performed comparing nonambulatory patients (GMFCS IV–V). The Wilcoxon-Rank Sum, Fisher exact, and χ^2 tests were utilized.

Results. The primary outcome measure, complication rates, was similar between the groups ($P = 0.09$). Preoperative Cobb angle, levels fused, fixation points, and LOS were similar ($P > 0.05$). EBL was significantly higher in CP patients, as was the rate of transfusion ($P = 0.001$) and surgical time ($P = 0.001$). Postoperative Cobb angle ($P = 0.002$) was significantly higher for CP patients. There was no significant difference between CP and RS patients in both preoperative ($P = 0.383$) and postoperative ($P = 0.051$) coronal decompensation. Nonambulatory status was associated with increased odds of having a postoperative complication (OR = 6.17, 95% CI = 1.36–28.04). Subanalysis of nonambulatory RS and CP patients revealed significantly higher postoperative Cobb ($P = 0.008$), EBL ($P = 0.019$), and surgical time ($P = 0.017$) in CP patients compared with RS patients. There were no significant differences in preoperative Cobb, levels fused, fixation points, hospital stay, or complication rate ($P > 0.05$).

Conclusion. RS patients are shown to have better outcomes than CP patients in terms of surgical, perioperative, and radiographic variables. Ambulatory status was identified as an independent risk factor for complications.

Key Words: neuromuscular scoliosis, pediatric

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Scoliosis is a common musculoskeletal condition in a wide array of neurodevelopmental disorders, such as Rett syndrome (RS) and cerebral palsy (CP).[1,2] RS is a relatively rare condition (1/10,000 births *vs.* 2–3/1000 births for CP).[3,4] Often progressive, neuromuscular scoliosis has the potential for cardiopulmonary compromise, making posterior spinal fusion (PSF) a frequent intervention aiming to correct spinal deformities and improve quality of life.[5–7]

RS is a rare, sex-linked neurodevelopmental disorder that has a high prevalence in females.[8,9] It is characterized by normal development for the first 6 to 18 months of life, followed by progressive loss of previously acquired cognitive, social, and motor milestones.[10] These children regress with social withdrawal and irritability that presents as autism, epilepsy, and difficulty with ambulation.[9] These severe disabilities persist into adult life, where affected individuals progressively deteriorate with scoliosis, dystonia, and rigidity, and become dependent on their caretakers for activities of daily living.[9]

RS is a type of neuromuscular scoliosis that typically maintains a long, C-shaped thoracolumbar kyphoscoliotic curve.[1] The onset is usually before 8 years of age, rapidly progressive, and increases with age. Surgical correction of these deformities has been shown to improve the quality of life for many patients.[11,12] Marr *et al.*[13] found the return of wellness and gross motor skills in RS patients within the first year after spinal fusion surgery. Although scoliosis occurs in 85% of the RS population, there is a lack of evidence describing how RS patients compare with other neuromuscular scoliosis conditions such as CP.

CP is a group of disorders that impact movement and posture; it has several characteristics in common with

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RS, such as the fact that the patients are often nonverbal and nonambulatory and have similar postoperative respiratory and surgical complications.[14,15] Patients with CP commonly have progressive spinal deformity as well. This condition contributes to difficulty sitting, along with pulmonary/neurological complications that can reduce a patient's functional capacity and result in an increased need for nursing care.[13,16]

Spinal fusion is often indicated in both CP and RS patients, which aims to improve balance, prevent curve progression, and improve overall quality of life and survival.[10,17,18] Factors such as curve severity and comorbidities can further increase the risk of complications.[7,19–21] Yaszay *et al*.[22] found a major complication rate of 36% and a reoperation rate of 14% in 257 CP patients who underwent PSF. Stone *et al*.[23] utilized the National Kids' Inpatient Database to evaluate RS patients undergoing PSF; they found that RS patients were associated with a higher rate of complications and increased length of stay compared with all other neuromuscular scoliosis patients.

Few studies have compared RS and CP patients undergoing PSF.[24,25] These studies had mixed results; for example, Cohen *et al*.[25] found that RS patients experienced more respiratory complications than CP patients, while Gabos *et al*.[24] found similar complication rates for RS patients. A dedicated scoliosis team can greatly improve outcomes and efficiency in institutions that treat a high volume of scoliosis cases.[26] The purpose of this study was to compare the perioperative outcomes of CP and RS patients following posterior spinal fusion for neuromuscular scoliosis. It is hypothesized that the two patient populations may have similar perioperative and radiographic outcomes after PSF for neuromuscular scoliosis.

MATERIALS AND METHODS

Institutional review board approval was obtained for this retrospective cohort study. All RS and CP patients who underwent PSF between 2005 and 2023 and had a full set of preoperative and postoperative radiographs were included in the study. The primary outcome measure was the 30-day complication rate. Secondary outcomes include estimated blood loss (EBL), operative time, transfusion, length of hospital stay, major Cobb angle, thoracic kyphosis (T5–T12), pelvic obliquity, coronal decompensation, number of levels fused, and fixation points. Patient characteristics, including age, sex, BMI, history of seizures, and pulmonary impairment, were collected.

Procedures were performed at two institutions by the same surgeon, and patients were treated by a dedicated scoliosis team. Patients undergo polysomnography, pulmonary workup, and nutrition consult preoperatively. Based on the patient's preoperative status, the patient can remain intubated for 24–48 hours, and this care is coordinated by a multidisciplinary PICU, anesthesia, and pulmonary team.

Subanalysis

Each set of patients was divided into two groups based on disease severity and ambulation: (1) independent or assisted ambulator (equivalent to GMFCS levels I–III) and (2) nonambulatory (GMFCS IV–V). Further analysis of demographic, perioperative, and radiographic outcomes was performed comparing nonambulatory (GMFCS IV–V) RS patients to nonambulatory CP patients. A subanalysis was not performed on ambulatory patients due to the small sample size of this cohort.

Statistical Analysis

Differences in demographics, radiographic outcomes, and perioperative outcomes between patients in RS and CP groups were compared using the Wilcoxon rank-sum test for continuous variables and χ^2 or Fisher exact tests for categorical variables. Continuous data is presented in the tables as median and interquartile range (IQR). Categorical data is presented in the tables as frequency and percentages. Normality assessments for continuous variables were assessed by the Kolmogorov-Smirnov (K-S) test and the Shapiro-Wilk test. All continuous variables were not normally distributed. Logistic regression was performed to identify factors associated with postoperative complications adjusted for RS/CP status. All P-values were two-tailed, with $P < 0.05$ considered significant. A post hoc power analysis was conducted to assess sample size. An independent biostatistician performed all statistical analyses using SAS software version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Overall-Patient Characteristics

Of the 116 patients who met the inclusion criteria (36 RS and 80 CP), the median age was 13.0 years old (11.0–14.1) for RS and 14.4 years old (11.7–17.4) for CP ($P = 0.009$) (Table 1). A history of seizures was identified in 15 (44.1%) RS patients and 50 (62.5%) CP patients ($P = 0.070$). A history of pulmonary impairment, such as pneumonia, restrictive lung disease, and chronic respiratory failure, was seen in 23 (29.1%) CP patients and 7 (19.4%) RS patients ($P = 0.274$).

Overall–Perioperative Outcomes

Surgery time (CP: 374.5 min *vs*. RS: 298 min) and EBL (CP: 800 mL *vs*. RS: 575 mL) were significantly higher for CP ($P < 0.001$) (Table 1). Sixty-five (87.8%) CP patients required blood transfusion, and 21 (58.3%) RS patients required blood transfusion, which was statistically significant ($P < 0.001$). Six (6.5%) of the CP patients did not have monitorable motor evoked potentials (MEPs) at the start of surgery. All CP patients had monitorable somatosensory evoked potentials (SSEPs). All RS patients had monitorable MEPs and SSEPs. Sixteen (44.4%) of RS patients were extubated in the OR, which was not statistically significant from 27 (33.8%) of CP patients ($P = 0.270$). There were 8 of 36 (22.2%) 30-day complications in the RS cohort and 31 of 80 (38.8%) 30-day complications in the CP cohort ($P = 0.66$). Of RS complications, there were 4 (11.1%) patients that returned with atelectasis, 1 (2.7%) with respiratory failure, and 3 (5.6%)

TABLE 1. Comparison of Demographic, Radiographic, and Perioperative Variables Between Rett Syndrome (RS) and Cerebral Palsy (CP) Patients That Underwent Posterior Spinal Fusion

	RS (n = 36)	CP (n = 80)	*P*
Age (yr)	13.0 (11.0–14.1)	14.4 (11.7–17.4)	**0.009**
BMI (kg/m^2)	19.5 (16.0–21.4)	17.6 (14.5–21.0)	0.120
Female, n (%)	36 (100)	44 (55.0)	**< 0.001**
History of seizures, n (%)	15 (44.1)	50 (62.5)	0.070
History of pulmonary impairment, n (%)	7 (19.4)	23 (29.1)	0.274
Primary outcome			
30-day complications, n (%)	8 (22.2)	31 (38.8)	0.098
Respiratory complication, n (%)	5 (62.5)	18 (58.1)	1.00
Secondary outcomes			
Preoperative Cobb (°)	68.0 (55.3–72.0)	73.0 (59.2–90.5)	0.081
Postoperative Cobb (°)	19.3 (16.2–29.0)	30.9 (19.5–44.0)	**0.002**
Cobb correction (%)	69.8 (60.8–78.5)	60.4 (47.2–68.3)	**0.015**
Levels fused	16.0 (15.0–17.0)	16.0 (15.0–17.0)	0.892
Fixation points	30.0 (28.0–33.0)	30.0 (27.0–33.0)	0.512
Preoperative kyphosis (°)	35.7 (25.2–43.0)	23.1 (15.1–40.0)	**0.016**
Postoperative kyphosis (°)	33.0 (21.7–35.3)	28.0 (19.2–39.5)	0.485
Preoperative pelvic obliquity (°)	8.7 (4.6–14.1)	12.0 (4.5–22.3)	0.104
Postoperative pelvic obliquity (°)	6.7 (3.0–11.1)	7.1 (3.2–14.3)	0.203
Preoperative decompensation (mm)	30.3 (15.2–99.2)	59.5 (16.3–144.2)	0.383
Postoperative decompensation (mm)	30.0 (12.8–42.5)	57.3 (19.0–99.0)	0.051
EBL (mL)	575.0 (350.0–850.0)	800.0 (600.0–1300.0)	**0.001**
Operative time (min)	298.0 (267.0–358.0)	374.5 (317.0–440.0)	**0.001**
Anesthesia time (min)	474.0 (420.0–513.0)	540.0 (477.0–596.5)	**0.001**
Difference in anesthesia and operative time (min)	150.0 (126.0–178.0)	155.0 (133.0–180.0)	0.717
Length of stay (d)	9.0 (7.0–13.8)	9.0 (6.0–14.5)	0.701
Transfusion, n (%)	21 (58.3)	65 (87.8)	**< 0.001**
Intra-op signal loss, n (%)	0	2 (2.5)	1.00
Extubated in OR, n (%)	16 (44.4)	27 (33.8)	0.270

Data are presented as median and interquartile range for continuous variables. Statistical values with $P < 0.05$ are considered statistically significant and bolded. *P*-values were obtained from Wilcoxon rank-sum tests for continuous variables, and χ^2 or Fisher exact tests for categorical variables.

patients with infections requiring irrigation and debridement (I&D). Of CP complications, there were 4 (5.0%) patients with atelectasis, 4 (5.0%) with wound infections, 6 (7.5%) requiring I&D, 5 (6.3%) with pleural effusion, 3 (3.8%) with gastrointestinal complications, 5 (6.3%) with respiratory distress, 1 (1.3%) with pulmonary interstitial edema, 1 (1.3%) with pneumonia, and 2 (2.5%) with urinary tract infections. Of the total complications for each group, 5 (62.5%) complications were respiratory in RS, compared with 18 (58.8%) respiratory complications in CP ($P = 1.0$).

Overall-Radiographic Findings

Preoperative Cobb angle did not have a statistically significant difference between CP (73.0°) and RS (68.0°) patients ($P = 0.081$), while postoperative Cobb angle was significantly lower in RS patients (CP: 30.9° *vs.* RS: 19.3°; $P = 0.002$) (Table 1). Cobb correction was significantly higher in RS patients (CP: 60.4% *vs.* RS: 69.8%; $P = 0.015$). Levels fused (CP: 16 *vs.* RS: 16; $P = 0.892$) were not statistically significant between the groups.

Subanalysis (Nonambulatory Patients)

In the subanalysis of nonambulatory patients, 72 CP and 21 RS patients were included (Table 2). There was no statistically significant difference with respect to age ($P = 0.098$), history of seizures ($P = 0.291$), pulmonary impairment ($P = 0.781$), or preoperative Cobb ($P = 0.073$). Postoperative Cobb was significantly lower in RS (19.3°) compared with CP (32.8°) patients. ($P = 0.008$). EBL ($P = 0.019$) and surgery time ($P = 0.017$) were significantly higher for CP patients compared with RS patients. There was no statistically significant difference in Cobb correction ($P = 0.089$), levels fused ($P = 0.298$), length of stay ($P = 0.083$), transfusion rate ($P = 0.152$), or 30-day complication rate ($P = 0.857$).

Subanalysis of Complications and Multivariable Logistic Regression

Complication rate comparing RS and CP for the overall ($P = 0.098$) and nonambulatory ($P = 0.619$) group; the difference was not statistically significant. Thirty-seven (39.4%) nonambulatory patients experienced complications, which was significantly higher than 2 (9.5%) ambulatory patients ($P = 0.010$) (Tables 3–4). On multivariable logistic regression, nonambulatory patients were more likely to have postoperative complications (OR = 5.41, 95% CI: 1.10–26.66; $P = 0.038$) compared with ambulatory patients. Patients with a history of seizures were more likely to have postoperative complications (OR = 4.20, 95% CI: 1.66–10.62; $P = 0.002$) compared with patients without a history of seizures.

DISCUSSION

There are few studies evaluating the outcomes of surgical correction in patients with RS and CP.[24]

TABLE 2. Comparison of Demographic, Radiographic, and Perioperative Outcomes Between Nonambulatory Rett Syndrome (RS) and Cerebral Palsy (CP) Patients

	RS (n = 21)	CP (n = 72)	*P*
Age (yr)	13.0 (11.0–14.5)	14.0 (11.7–17.0)	0.098
BMI (kg^2/m)	19.5 (15.4–20.0)	17.7 (14.3–21.0)	0.564
Female, n (%)	21 (100)	38 (52.8)	**< 0.001**
History of seizures, n (%)	9 (52.9)	46 (66.7)	0.291
History of pulmonary impairment, n (%)	5 (26.3)	22 (32.4)	0.781
Primary outcome			
30-day complications, n (%)	10 (47.6)	29 (40.3)	0.619
Secondary outcomes			
Preoperative Cobb (°)	68.0 (50.6–72.0)	75.0 (60.0–95.0)	0.073
Postoperative Cobb (°)	19.3 (17.9–28.3)	32.8 (20.9–45.0)	**0.008**
Cobb correction (%)	67.3 (56.3–76.5)	57.5 (45.9–68.1)	0.089
Levels fused	17.0 (15.0–17.0)	16.0 (15.0–17.0)	0.298
Fixation points	31.5 (28.5–33.0)	30.0 (28.0–33.0)	0.409
Preoperative kyphosis (°)	37.8 (24.0–43.0)	24.0 (16.0–41.0)	0.230
Postoperative kyphosis (°)	33.0 (27.9–35.3)	28.0 (19.5–39.5)	0.564
Preoperative pelvic obliquity (°)	13.1 (3.8–17.0)	12.0 (4.8–22.0)	0.445
Postoperative pelvic obliquity (°)	6.9 (3.3–12.0)	7.1 (3.2–14.3)	0.790
Preoperative decompensation (°)	78.9 (20.6–145.0)	62.6 (15.3–146.8)	0.973
Postoperative decompensation (°)	37.5 (12.0–87.3)	57.3 (19.0–103.3)	0.606
EBL (mL)	550.0 (250.0–1000.0)	800.0 (600.0–1500.0)	**0.019**
Operative time (min)	306.5 (275.0–385.5)	385.5 (317.0–449.0)	**0.017**
Anesthesia time (min)	490.0 (430.0–550.0)	541.0 (480.0–609.5)	0.054
Difference in anesthesia and operative time (min)	164.0 (127.5–194.0)	155.0 (134.5–180.0)	0.813
LOS (d)	12.0 (9.0–16.0)	10.0 (6.0–16.0)	0.083
Transfusion, n (%)	16 (76.2)	59 (89.4)	0.152
Intraoperative signal loss, n (%)	0	2 (2.8)	1.000
Extubated in OR, n (%)	7 (33.3)	23 (31.9)	0.905

Data are presented as median and interquartile range for continuous variables. Statistical values with $P < 0.05$ are considered statistically significant and bolded. *P*-values were obtained from Wilcoxon rank-sum tests for continuous variables and χ^2 or Fisher exact tests for categorical variables.

Respiratory and motor dysfunction are a few of the characteristics that limit the activities of daily living for these patients.[1] We compared the perioperative outcomes of these two cohorts as part of our investigation to help surgeons guide patient and family expectations with RS and the outcomes of surgical stabilization. We examined whether there were any similarities or differences between these two populations with neuromuscular scoliosis, to help guide clinical decision-making. There were two main findings in this study: (a) RS patients have superior radiographic and perioperative outcomes compared with CP, and (b) nonambulatory status and history of seizures are independent risk factors for postoperative complications in both groups.

Our study found RS patients had significantly better outcomes in terms of blood loss, transfusion rate, surgical time, and anesthesia time. Our study showed similar preoperative Cobb angle for both groups, but lower postoperative Cobb angle and higher Cobb correction in the RS group, indicating greater curve correction potential in RS patients compared with CP patients. In CP patients, spinal deformity is contributed to by muscle spasticity; this is not the case in RS patients.[27,28] Other studies have reported a 45%–65% Cobb correction in CP patients, similar to our 60.4% Cobb correction.[27] The spastic muscles may have possibly limited the degree of correction in CP patients compared with RS patients, but this association is not strongly established in the literature. In a previous study conducted by Rumbak *et al.*[14] comparing 8 RS patients to 48 neurological scoliosis patients and 133 adolescent idiopathic scoliosis patients, RS patients were found to have higher EBL and anesthesia time compared with the other two groups. However, due to the small sample size and wider range of diagnoses seen in the neurological scoliosis group, the authors contend their study has low power and requires a larger, prospective study to validate their findings. In a larger study with 21 RS patients and 124 CP patients, Cohen *et al.*[25] found shorter anesthesia and surgical times for RS patients compared with CP patients, in concordance with our findings. In our study, RS patients had significantly lower blood loss and shorter surgeries. One potential explanation for these outcomes is that CP patients have muscle spasticity, resulting in rigid and stiff muscles.[5,28]

TABLE 3. Subanalysis of 30-Day Complication Rate by Ambulatory Status

30-day complications by group, N (%)	Ambulatory	Nonambulatory	*P*
Rett syndrome (n = 36)	1 (7.7)	7 (31.8)	0.211
Cerebral palsy (n = 80)	1 (12.5)	30 (41.7)	0.142
Total group (n = 116)	2 (9.5)	37 (39.4)	**0.010**

Statistical values with P < 0.05 are considered statistically significant and bolded.
P-values were obtained by the Fisher exact test for categorical variables.

TABLE 4. Factors Associated With Postoperative Complications on Multivariable Logistic Regression

Characteristic	Odds ratio (95% CI)	*P*
Nonambulatory	5.41 (1.10–26.66)	**0.038**
History of seizures	4.20 (1.66–10.62)	**0.002**
Rett syndrome	0.87 (0.31–2.43)	0.786
Cerebral palsy (reference)	1	

Statistical values with P <0.05 are considered statistically significant and bolded.

Friden *et al.*[28] found that compared with "normal" muscle cells from neuromuscular patients, spastic muscle cells from patients with CP have a shorter sarcomere resting length and impaired extracellular components. Muscle dissection for CP patients may take longer and result in higher blood loss compared with RS patients due to this impaired muscle physiology, resulting in higher surgical time and EBL compared with other neuromuscular diagnoses.[28–31]

Our study found a similar rate of 30-day complications between the two groups. Gabos and colleagues compared 16 RS patients with 32 spastic quadriplegic CP patients for complications during and after hospital stay for PSF. Gabos *et al.*[24] found no significant difference in postoperative complications between RS and CP patients. They also found that major respiratory complications were seen in 63% of RS patients and comprised 61% of all major medical complications for RS patients.[24] Cohen *et al.*[25] found a significantly higher respiratory failure rate of 43% in RS patients compared with 19% in CP patients. Rumbak *et al.*[14] found higher rates of respiratory failure in RS patients as well. We defined respiratory complications to include respiratory failure, atelectasis, and pleural effusion. RS and CP patients had similar pulmonary impairment rates going into surgery. Both conditions present with altered respiratory mechanics due to muscle weakness and restrictive respiratory defects from progressive scoliosis.[32–34] Likewise, we found that RS patients had a similar 30-day respiratory complication rate (62.5%) out of total complications compared with CP patients (58.8%), indicating that respiratory complications do not disproportionately affect one group over the other ($P=1.0$). These findings can be attributed to our institution's protocol, where neuromuscular patients receive prolonged noninvasive ventilatory support and airway clearance techniques for an extended amount of time postoperatively.[35] This allows time for the lungs to accommodate and potentially allows for improved pain control and fewer respiratory complications.[35,36] Implementation of a multidisciplinary scoliosis team and surgical standardization at institutions can also help explain these improved outcomes for RS patients.[26]

In our subanalysis of nonambulatory (GMFCS IV-V) CP patients compared with RS patients, we found similar findings to our overall analysis. We also found that patients who were nonambulatory were significantly more likely to experience a postoperative complication compared with ambulatory patients (39.4% *vs.* 9.5%, $P=0.01$). Master *et al.*[37] found in a previous study that non-ambulatory NMS patients had four times greater risk of major complications following spinal fusion compared with ambulatory NMS patients. Previous studies have found that when matched on age, sex, levels fused, and preoperative Cobb angle, ambulatory NMS and adolescent idiopathic scoliosis patients experienced similar EBL, transfusion rates, and complication rates.[38] Nonambulatory NMS patients were more likely to have more comorbidities and severe disease impairment, which increases complication risk.[38] In this study, ambulatory status was identified as an independent risk factor for postoperative complications in both cohorts. However, Downs *et al.*[8] found that scoliosis surgery was associated with improved wellness and quality of life for wheelchair-bound RS patients. Therefore, although nonambulatory patients were found in our study to have a higher risk of developing postoperative complications, these patients are also more able to benefit from this surgical intervention.[8]

This study is not without limitations. We did not perform an assessment of caregiver-oriented outcomes in our patient cohorts. Previous studies have shown positive results with high satisfaction rates among caregivers for PSF, despite minor and major complications, and improved caregiving and overall quality of life for the patient.[5,17,39] Second, due to the low number of eligible patients in the study, data were collected from two different hospitals. Based on the complication rates reported by Cohen *et al.*[25] of 9/21 (43%) RS and 23/124 (19%) CP patients, post hoc power analysis reveals that our study is 80% powered to detect the 24% difference at a two-sided 0.05 significance level. However, we did not find the complication rate to be significantly different, with 8/36 (22.2%) in RS and 31/80 (38.8%) in CP. For this 16.6% difference, our current sample size is 43.3% powered to detect a difference at a two-sided 0.05 significance level. The power analysis suggests that future studies will need a sample size of 129 in each group to detect this difference with 80% power. RS is a rare disease that involves a small population; attaining 129 patients would be difficult even in a multi-institutional design. At this time, the present study has the largest population of RS patients reviewed and was adequately powered to detect a significant difference in EBL, transfusion rates, and operative time.

CONCLUSION

This study uniquely found more positive curve correction and perioperative outcomes in RS patients compared with CP patients. The differences seen between RS and CP patients translated to our nonambulatory subgroup. While RS patients in the past have shown less favorable surgical outcomes compared with other patient groups, our institution was able to see improved outcomes for this group. Further studies with larger sample sizes are needed to validate these findings.

➢ Key Points

- ❑ Rett syndrome patients had superior perioperative outcomes compared with cerebral palsy patients.
- ❑ Nonambulatory status is an independent risk factor for postoperative complications in both Rett syndrome and cerebral palsy patients.
- ❑ There were no differences in respiratory complications between Rett syndrome and cerebral palsy patients.

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