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DEFORMITY

Surgical Factors and Treatment Severity for Perioperative Complications Predict Hospital Length of Stay in Adult Spinal Deformity Surgery

Hai V. Le, MD,[a] Joseph B. Wick, MD,[a] Renaud Lafage, MS,[b] Michael P. Kelly, MD,[c] Han Jo Kim, MD,[b] Munish C. Gupta, MD,[c] Shay Bess, MD,[d] Douglas C. Burton, MD,[e] Christopher P. Ames, MD,[f] Justin S. Smith, MD,[g] Christopher I. Shaffrey, MD,[h] Frank J. Schwab, MD,[b] Peter G. Passias, MD,[i] Themistocles S. Protopsaltis, MD,[i] Virginie Lafage, PhD,[b] and Eric O. Klineberg, MD, MS[a], International Spine Study Group

Study Design. Retrospective review of prospectively collected multicenter registry data.

Objective. The aim of this study was to determine whether surgical variables and complications as graded by treatment severity impact postoperative hospital length of stay (LOS).

Summary of Background Data. Surgical treatment can substantially improve quality of life for patients with adult spinal deformity (ASD). However, surgical treatment is associated with high complication rates, which may impact hospital LOS. Classifying complications by severity of subsequent treatment may allow surgeons to better understand complications and predict their impact on important outcome metrics, including LOS.

Methods. Patients enrolled in a multicenter, prospectively enrolled database for ASD were assessed for study inclusion. Complications were graded based on intervention severity. Associations between LOS, complication intervention severity, and surgical variables (fusion length, use of interbody fusion, use of major osteotomy, primary versus revision surgery, same day *vs.* staged surgery, and surgical approach), were assessed. Two multivariate regression models were constructed to assess for independent associations with LOS.

Results. Of 1183 patients meeting inclusion criteria, 708 did not and 475 did experience a perioperative complication during their index hospitalization, with 660 and 436 included in the final cohorts, respectively. Among those with complications, intervention severities included 14.9% with no intervention, 68.6% with minor, 8.9% with moderate, and 7.6% with severe interventions. Multivariate regression modeling demonstrated that length of posterior fusion, use of major osteotomy, staged surgery, and severity of intervention for complications were significantly associated with LOS.

Conclusion. Careful selection of surgical factors may help reduce hospital LOS following surgery for ASD. Classification of complications by treatment severity can help surgeons better understand and predict the implications of complications, in turn assisting with surgical planning and patient counseling.

Key words: adult spinal deformity, classification, complication, degenerative, intervention, length of stay, lumbar, outcome, outcomes, pedicle subtraction osteotomy, perioperative, postoperative, scoliosis, thoracolumbar, vertebral column resection.

Level of Evidence: 4

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From the [a]Department of Orthopaedic Surgery, UC Davis Medical Center, Sacramento, CA; [b]Hospital for Special Surgery, New York, NY; [c]Department of Orthopaedic Surgery, Washington University School of Medicine, St. Louis, MO; [d]Denver International Spine Center, Presbyterian St. Luke's/Rocky Mountain Hospital for Children, Denver, CO; [e]Department of Orthopaedic Surgery, University of Kansas School of Medicine, Kansas City, KS; [f]Department of Neurosurgery, University of California, San Francisco, CA; [g]Department of Neurosurgery, University of Virginia Medical Center, Charlottesville, VA; [h]Departments of Neurosurgery and Orthopedic Surgery, Duke Medical Center, Durham, NC; and [i]Department of Orthopedic Surgery, NYU Langone Health, New York, NY.

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Address correspondence and reprint requests to Hai V. Le, MD, University of California, Davis, 4860 Y Street, Suite 3800, Sacramento, CA 95817; E-mail: haile@ucdavis.edu

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Patients with adult spinal deformity (ASD) can have debilitating pain, functional decline, or neurological compromise.[1] As such, ASD can have a significant negative impact on health-related quality of life,[2–4] with ASD patients reporting worse health-related outcome measures compared to adults with other chronic conditions, including arthritis, chronic lung disease, diabetes, and congestive heart

failure.[3] When nonoperative treatment options have been exhausted, complex spinal reconstruction can offer ASD patients meaningful improvement in pain and function.[5,6] However, ASD surgery poses substantial medical and surgical risks.[7,8] In a prospective multicenter study by Smith et al, the authors observed 69.8% of patients sustained perioperative (within 6 weeks of surgery) or delayed complications.[7] Given the high incidence of complications after ASD surgery, a major focus in ASD research has been on complication avoidance, management, and classification. There is presently no well-established complication classification for ASD. Although most studies have classified complications as either major or minor,[7–9] this approach lacks granularity to predict outcomes and impact. Moreover, there is no clear consensus as to what delineates a complication as major or minor. For example, Sciubba et al defined a major complication as any that ''substantially prolonged hospitalization, involved an invasive intervention, had prolonged or permanent morbidity, or resulted in death.''[8] This definition leaves room for interpretation and thus opportunities to introduce bias. Furthermore, binary classification of complications as major or minor does not allow surgeons to appreciate the graded severity of each complication.

Given the need for an improved ASD complication classification system, a multidisciplinary effort utilizing a Delphi approach was utilized to develop a comprehensive complication classification system.[10] The resulting system grades complications by type (medical or surgical) with four complication modifiers: neurological impact, timing of complication diagnosis, intervention severity, and resolution status (Figures 1 and 2).[10–13] Although each complication modifier is intended to increase classification granularity and potentially improve surgeons' ability to understand and predict the impact of complications, there is a lack of data demonstrating the impact of intervention severity on patient outcomes. The present study was therefore designed to assess whether surgical factors and intervention severity for complications may impact patient outcomes, specifically hospital length of stay (LOS).

MATERIALS AND METHODS

Patients and Covariates

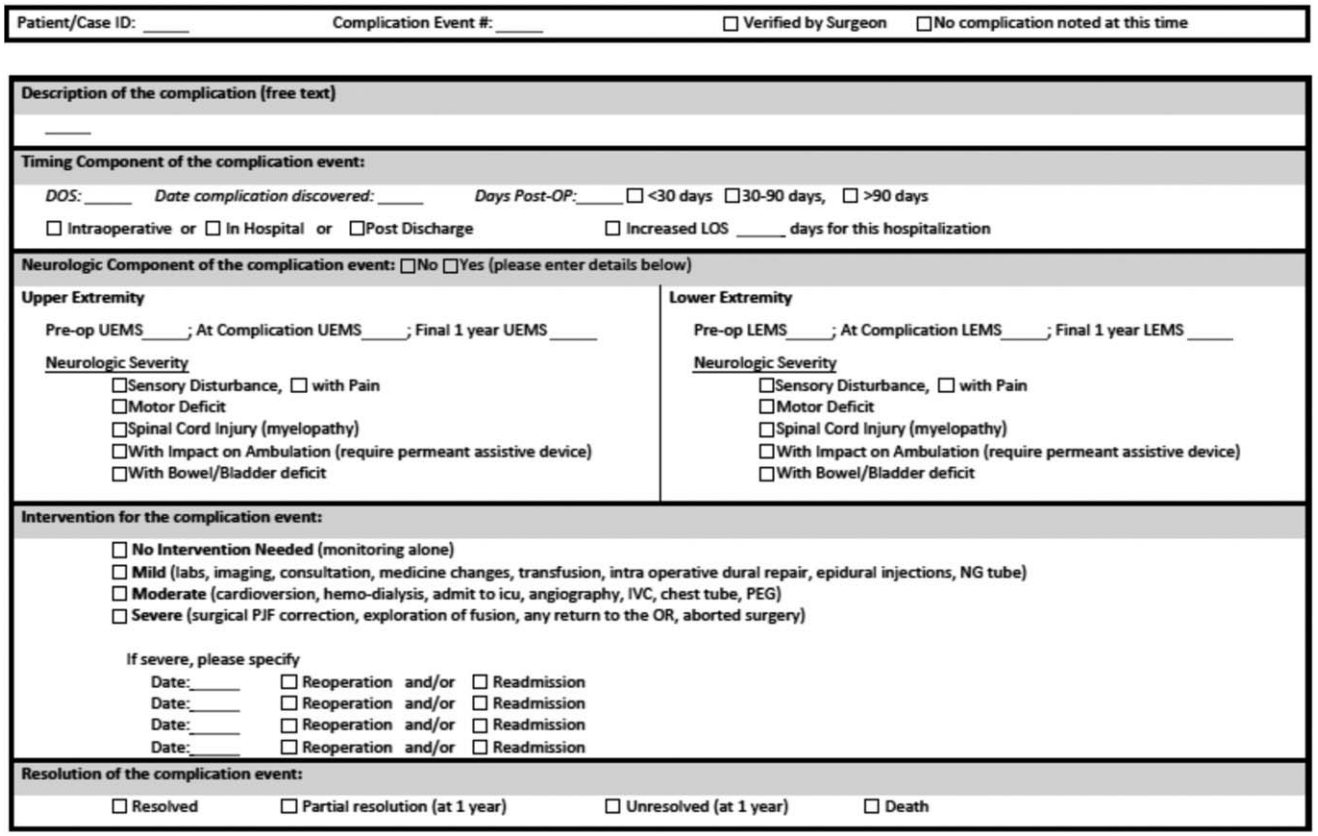
Patients from a prospective, consecutively enrolled multicenter ASD database were included in this study. Institutional Review Board (IRB) approval was obtained at each

Patient/Case ID: _____ Complication Event #: _____ ☐ Verified by Surgeon ☐ No complication noted at this time

Complication events should be attributed to the surgical intervention. Each complication event may have multiple components checked below. Please fill out** one separate form for each complication event **(example: event1 = PJK + neuro deficit + hook dislodgement; event2=UTI only)

Medical	☐ Cancer	☐Local	☐Distant Site		
	☐ Renal	☐Electrolyte abnormality	☐Renal dysfunction	☐Renal Failure	
	☐ Infection	☐UTI ☐ Sepsis	☐CdiffThrush	☐Non-wound cellulitis	☐Pneumonia
	☐ Cardiac	☐Arrhythmia ☐PE ☐Thrombocytopenia	☐Congestive heart failure ☐DVT	☐Myocardial infarction ☐Hypotension ☐Hypertension	☐Bradycardia ☐Tachycardia
	☐ Pulmonary	☐ARDS ☐Respiratory Failure	☐Atelectasis ☐Short of Breath (SOB)	☐Reintubation	☐Pulmonary Effusion
	☐ Gastro	☐Ileus ☐Pancreatitis	☐GI Bleed ☐Dysphagia	☐Cholecystitis	☐SMA syndrome
	☐ CNS	☐Delirium	☐Seizure	☐CVA / stroke	
	☐ Musculoskeletal	☐Trochanteric Bursitis ☐Cervical spine degeneration ☐Lumbar spine degeneration	☐Distant site spine pain ☐Distant non spine pain ☐Non-surgical site spine fracture	☐THA dislocation ☐Large Joint degeneration	☐Non spine fracture
Surgical	☐Implant	☐Rod/screw Breakage ☐Implant Prominence	☐Dislodgement or Loosening	☐Screw Malposition	☐Painful implants
	☐Radiographic	☐Adjacent segment degeneration ☐Interspinous Ligament disruption ☐Heterotopic ossification	☐Coronal imbalance ☐Flatback deformity ☐Sagittal imbalance	☐Vertebral body fracture ☐Pedicle Fracture ☐Pseudarthrosis	☐ DJK ☐ PJK ☐ PJF
	☐Neurologic	☐Spinal cord injury/myelopathy ☐Neuropathy/Sensory deficit/Pain ☐Bowel/Bladder dysfunction	☐Positioning ulnar neuropathy ☐Recurrent laryngeal nerve injury /dysphonia ☐Femoral cutaneous neuralgia	☐Retrograde ejaculation ☐Horner's syndrome ☐Brachial plexus injury	☐Motor deficit ☐Visual deficit ☐Delayed C5 palsy
	☐Operative	☐Unintended extension of fusion ☐Intraop monitoring abnormality ☐Retained instrument/sponge	☐Anesthesia Complication ☐Positioning complication ☐Coagulopathy	☐Visceral injury ☐Vascular injury ☐Lymphocele	☐Massive EBL (>4L) ☐Anemia Blood Loss ☐Dural tear
	☐Wound/Approach	☐Hematoma/seroma ☐Epidural Hematoma	☐Wound Drainage ☐ Dehiscence	☐Superficial ☐Deep	☐Incisional Hernia

Figure 1. Complications reporting form for the International Spine Study Group-AO (ISSG-AO) Multi-Domain Surgical Complication Classification System for Adult Spinal Deformity. Complications are categorized as medical or surgical, then sub-categorized based on specific complication types.


Patient/Case ID: _____ Complication Event #: _____ ☐ Verified by Surgeon ☐ No complication noted at this time

Description of the complication (free text)

_____

Timing Component of the complication event:

DOS: _____ *Date complication discovered:* _____ *Days Post-OP:* _____ ☐ <30 days ☐ 30-90 days, ☐ >90 days

☐ Intraoperative or ☐ In Hospital or ☐ Post Discharge ☐ Increased LOS _____ days for this hospitalization

Neurologic Component of the complication event: ☐ No ☐ Yes (please enter details below)

Upper Extremity

Pre-op UEMS_____; At Complication UEMS_____; Final 1 year UEMS _____

Neurologic Severity

☐ Sensory Disturbance, ☐ with Pain
☐ Motor Deficit
☐ Spinal Cord Injury (myelopathy)
☐ With Impact on Ambulation (require permeant assistive device)
☐ With Bowel/Bladder deficit

Lower Extremity

Pre-op LEMS_____; At Complication LEMS_____; Final 1 year LEMS _____

Neurologic Severity

☐ Sensory Disturbance, ☐ with Pain
☐ Motor Deficit
☐ Spinal Cord Injury (myelopathy)
☐ With Impact on Ambulation (require permeant assistive device)
☐ With Bowel/Bladder deficit

Intervention for the complication event:

☐ **No Intervention Needed** (monitoring alone)
☐ **Mild** (labs, imaging, consultation, medicine changes, transfusion, intra operative dural repair, epidural injections, NG tube)
☐ **Moderate** (cardioversion, hemo-dialysis, admit to icu, angiography, IVC, chest tube, PEG)
☐ **Severe** (surgical PJF correction, exploration of fusion, any return to the OR, aborted surgery)

If severe, please specify

Date:_____ ☐ Reoperation and/or ☐ Readmission
Date:_____ ☐ Reoperation and/or ☐ Readmission
Date:_____ ☐ Reoperation and/or ☐ Readmission
Date:_____ ☐ Reoperation and/or ☐ Readmission

Resolution of the complication event:

☐ Resolved ☐ Partial resolution (at 1 year) ☐ Unresolved (at 1 year) ☐ Death

Figure 2. Complications reporting form for the International Spine Study Group-AO (ISSG-AO) Multi-Domain Surgical Complication Classification System for Adult Spinal Deformity. Complication details recorded include timing, neurologic component, intervention grading, and complication resolution.

participating site before study initiation. All patients >18 years old who underwent ASD surgery were assessed for inclusion. Basic demographic data including sex, age, body mass index (BMI), and American Society of Anesthesiologists (ASA) physical status classification were collected on all study subjects. In addition, surgical data including the number of posterior levels fused, presence of interbody fusion, use of a major osteotomy including pedicle subtraction osteotomy (PSO) or vertebral column resection (VCR), primary *versus* revision surgery, same day *versus* staged surgery, and surgical approach (posterior only *vs.* combined) were obtained. For comparison purposes, posterior fusion length was further categorized as short (less than five segments), medium (five to 13 segments), and long (>13 segments). The primary outcome of interest was LOS. Complications were recorded and categorized by intervention severity (0 = none, 1 = minor, 2 = moderate, 3 = severe) as listed in Figure 2 and Table 1. For patients sustaining multiple complications during their initial hospitalization, only the highest severity intervention was considered in the final analysis.

TABLE 1. Intervention Severity Grading Based on the ISSG-AO Adult Spinal Deformity Complications Classification System

Intervention Severity	Example
No intervention	N/A
Mild intervention	Labs Imaging studies Medication changes Transfusion Intraoperative dural repair Epidural injections Nasogastric tube placement
Moderate intervention	Cardioversion Hemodialysis Intensive Care Unit admission Angiography Inferior vena cava filter placement Chest tube placement Percutaneous endoscopic gastrostomy tube placement
Severe intervention	Surgical correction of proximal junctional failure Exploration of fusion Any return to operating room Aborted surgery

Statistical Analysis

Patients both with and without complications before discharge were assessed. Those without complications were treated as the reference group. To prevent outlier bias,

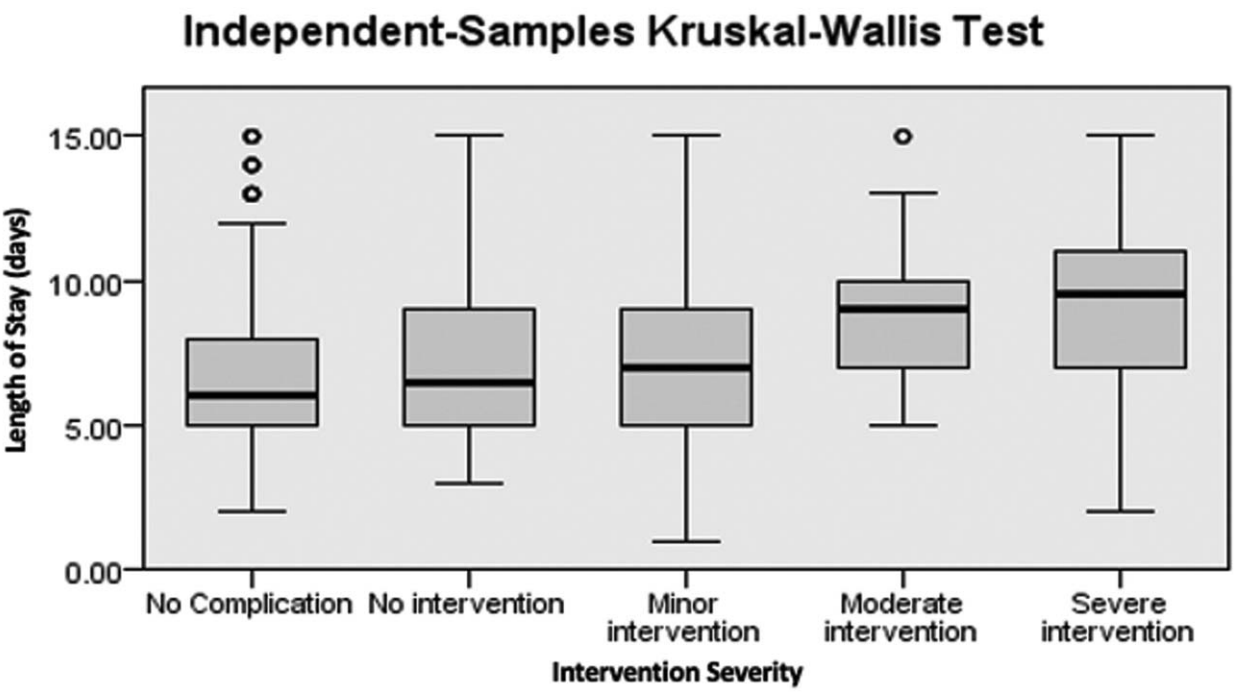


Figure 3. Results of independent samples Kruskal-Wallis tests for associations of increasing complication intervention severity with postoperative hospital length of stay among patients undergoing surgery for adult spinal deformity. Dark black lines represent median values; boxes represent interquartile ranges. Intervention severity was graded based on the International Spine Study Group-AO (ISSG-AO) Multi-Domain Surgical Complication Classification System for Adult Spinal Deformity.

patients with excessive LOS were removed from the final analysis. Outliers were defined as those with LOS less than the 25th percentile minus 1.5 times the interquartile range, and those with LOS exceeding the 75th percentile plus 1.5 times the interquartile range, for a final LOS range from 0 to 16 days. LOS was non-normally distributed; therefore, univariate analyses were performed using Kruskal-Wallis tests to assess associations of intervention severity (Figure 3), fusion length, use of interbody fusion, use of major osteotomy, primary *versus* revision surgery, approach, and staged surgery on LOS. Two separate multivariate regression models were subsequently constructed with LOS as the outcome of interest. The models were constructed using Poisson regression with LOS as an ordinal variable, and negative binomial with log link modeling with LOS as a continuous variable. Independent variables in the regression models included type of intervention by severity, grouped posterior fusion lengths, use of interbody fusion, use of major osteotomy, primary *versus* revision surgery, approach, and staged surgery. Goodness of fit and omnibus tests were performed to assess regression model performance. Statistical tests were performed using SPSS 20.0 (IBM Corp, Armonk, NY) and R Statistical Package (R Core Team, Vienna, Austria), with level of significance defined as $P = 0.05$.

RESULTS

Patients and Surgical Factors

A total of 1183 patients met inclusion criteria. Of these, 708 did not and 475 did experience a perioperative complication. With outliers removed, 660 patients without complications were included in the final analysis. In univariate analysis of the cohort without complications, the median LOS was 6.1 days (SD 2.2) and was significantly affected by longer length of posterior fusion ($P < 0.01$), use of a major osteotomy ($P = 0.02$), combined approach ($P < 0.01$), and staged surgery ($P < 0.01$). Revision surgery ($P = 0.75$) or use of interbody fusion ($P = 0.17$) did not significantly impact LOS (Table 2). In contrast, 475 patients had a complication during their index hospitalization for ASD surgery. With outliers removed, 436 patients who experienced complications were included in the final analysis. Among this cohort, the mean age was 61years, and 73.8% were female. The mean BMI was 28.1 kg/m^2, mean ASA grade was 2.4, and the mean LOS was 7.7days (SD 2.9). The reoperation rate was 6.7%. LOS was significantly affected by posterior fusion length ($P < 0.01$), major osteotomy ($P < 0.01$), and staged surgery ($P < 0.01$) (Table 3).

Impact of Intervention Severity

Among the complication cohort, graded intervention severities included 14.9% with no intervention, 68.6% with minor, 8.9% with moderate, and 7.6% undergoing severe interventions (Figure 2, Table 4). The mean LOS by intervention severity was as follows: no intervention, 7.6 days; minor, 7.5 days; moderate, 9.1 days; and severe, 9.0 days ($P < 0.01$). Multivariate regression analyses (Table 5) were confirmed to fit the data using goodness of fit and Omnibus testing. Specifically, for the Poisson regression, Pearson χ^2 value was 0.779 with omnibus test

TABLE 2. Surgical Factors Affecting Length of Stay in Patients Without Complications During Initial Hospitalization

Surgical Factors	Mean Length of Stay	*P*
Posterior fusion length		<0.01
Short: less than five segments	4.2 (2.1)	
Medium: 5–13 segments	6.4 (2.0)	
Long: >13 segments	6.9 (1.9)	
Major osteotomy*		0.02
No	6.1 (2.2)	
Yes	6.6 (1.8)	
Interbody graft		0.17
No	6.0 (1.7)	
Yes	6.2 (2.4)	
Surgery type		0.75
Primary	6.2 (2.2)	
Revision	6.1 (2.1)	
Surgical approach		<0.01
Posterior only	6.0 (1.8)	
Combined	6.6 (2.7)	
Timing of surgery		<0.01
Same day	5.8 (2.0)	
Staged	8.1 (2.1)	

Defined as pedicle subtraction osteotomy or vertebral column resection. Level of significance set at P = 0.05.

significance value $P < 0.001$. For the negative binomial model, Pearson χ^2 was 0.104 with omnibus significance value $P < 0.001$. From the Poisson analysis, length of posterior fusion, use of major osteotomy, staged surgery, and severity of intervention were significantly associated with increased LOS. In the negative binomial model, length of posterior fusion, staged surgery, and severity of intervention were significant independent predictors of LOS, whereas use of major osteotomy was not a significant independent predictor of LOS.

TABLE 3. Surgical Factors Affecting Hospital Length of Stay in Patients Experiencing Complications During Their Index Hospitalization

Surgical Factors	Mean Length of Stay	*P*
Posterior Fusion Length		<0.01
Short: less than five segments	6.2 (2.6)	
Medium: 5–13 segments	7.6 (2.8)	
Long: >13 segments	8.3 (2.9)	
Major osteotomy*		<0.01
No	7.5 (2.8)	
Yes	8.5 (3.0)	
Interbody graft		0.13
No	7.4 (2.5)	
Yes	7.9 (3.0)	
Surgery type		0.30
Primary	7.6 (2.7)	
Revision	8.0 (3.1)	
Surgical approach		0.31
Posterior only	7.6 (2.7)	
Combined	8.1 (3.2)	
Timing of surgery		<0.01
Same day	7.5 (2.7)	
Staged	9.0 (3.3)	

Defined as pedicle subtraction osteotomy or vertebral column resection. Level of significance set at P = 0.05.

TABLE 4. Impact of Intervention Severity on Hospital Length of Stay

Intervention Severity	Frequency, n (%)	Length of Stay
No intervention	65 (14.9%)	7.6 (SD 3.2)
Minor intervention	299 (68.6%)	7.5 (SD 2.6)
Moderate intervention	39 (8.9%)	9.1 (SD 3.0)
Severe intervention	33 (7.6%)	9.0 (SD 3.5)

DISCUSSION

In this study, we assessed impact of perioperative factors and complication intervention severity on hospital LOS, which is a commonly used surgical outcome metric and target for quality improvement.[14–17] Indeed, reducing LOS is one of the primary objectives in widely adopted Enhanced Recovery After Surgery protocols.[18,19] Understanding the impact of complication intervention severity is important, and complication severity has been included in a recently developed ASD complication classification system.[10] Assessing the implications of complication intervention is especially relevant in ASD surgery, which is complex with substantial risk for perioperative morbidity including prolonged hospitalization.

The mean LOS after ASD surgery has been reported to be approximately 8 days, but varies significantly depending on multiple medical and surgical factors.[20,21] In patients without in-hospital complications, we identified four significant surgical predictors of LOS, including longer posterior fusion length, use of a major osteotomy (PSO or VCR), combined approach, and staged surgery. Among those with a complication, fusion length, use of a major osteotomy, and staged surgery were associated with prolonged LOS. As anticipated, patients who sustained in-hospital complications after ASD surgery had significantly longer hospitalizations (7.7 *vs.* 6.1 days, $P < 0.01$). Many previously published studies have affirmed the effect of complications on LOS after ASD surgery. For example, Klineberg *et al* found extended LOS after ASD surgery was affected by comorbidities and number of intraoperative complications.[21] Our results suggest that modulating operative factors by choice of osteotomies, fusion length, and staging may impact LOS.

TABLE 5. Results of Multivariate Analyses Evaluating The Dependent Variable, Length of Stay, as Both an Ordinal Variable (Poisson Regression Model) and Continuous Variable (Negative Binomial Regression Model)

Poisson Regression Model		
Covariate	**B-coefficient**	***P***
Fusion length 5–13 segments*	0.324	0.000
Fusion length >13 segments*	0.378	0.000
Major osteotomy	0.114	0.001
Interbody fusion	0.052	0.096
Revision	−0.032	0.969
Posterior *vs.* combined approach	−0.061	0.131
Staged	0.344	0.000
No intervention†	0.183	0.000
Minor intervention†	0.129	0.000
Moderate intervention†	0.299	0.000
Severe intervention†	0.184	0.007
Negative Binomial Model		
Covariate	**B-coefficient**	***P***
Fusion length	0.142	0.027
Major osteotomy	0.111	0.274
Interbody fusion	0.037	0.663
Revision	−0.032	0.697
Posterior *vs.* combined approach	−0.102	0.340
Staged	0.393	0.000
Intervention severity	0.071	0.027

**With fusion less than five segments treated as reference group.*

†With no complication as reference group. Major osteotomy defined as pedicle subtraction osteotomy or vertebral column resection. Level of significance set at P = 0.05.

To date, complication classification in ASD has been limited by lack of a comprehensive classification system. Previous ASD complication studies have classified complications as minor versus major or perioperative (<6 weeks) *versus* delayed,[7–9] and have been unable to find any effect of complications on one-year outcome measures.[9] This suggests that lack of granularity in complication classification systems may by inhibiting surgeons' ability to adequately predict complications' impact on outcomes. In response, there has been a concerted effort to develop a more comprehensive complication classification for ASD to better define and grade complications. One result of this effort has been the International Spine Study Group-AO (ISSG-AO) Multi-Domain Surgical Complication Classification System for Adult Spinal Deformity,[10] which organizes complications by type (medical or surgical) with four modifiers: neurological impact, timing of complication diagnosis, intervention severity, and resolution sta-tus.[10,13] Within the ISSG-AO system, intervention severity is classified as none, minor, moderate, or severe. Although the complication rates following ASD surgery are high,[7,8] our study showed most in-hospital complications required no intervention (14.9%) or minor intervention (68.6%). We observed LOS was not only correlated to in-hospital complications but also to complication intervention severity grade. There were significant differences in LOS between intervention groups. Consequently, our results suggest that classifying complications by intervention severity, as in the ISSG-AO classification system, may help surgeons better understand and predict the impact of each complication on various outcome measures.

Classification of postoperative complications by intervention invasiveness is not a new concept. In 1992, Clavien *et al* published what is now commonly known as the Clavien-Dindo Classification of surgical complications.[22,23] This classification was later modified in 2004 and consists of five severity grades.[24] The authors tested their classification system in a cohort of 6336 patients undergoing elective general surgery and found it correlated with surgical complexity and LOS.[24] Although the Clavien-Dindo Classification is more often used in the general surgery literature, it has recently gained traction in spine surgery.[25,26] Nonetheless, the classification is not solely based on complication intervention; grade IV severity, for example, relies more on whether the complication causes single organ versus multiorgan dysfunction. As pointed out by the authors, the system "mostly relies on the therapy used to treat the complication."[24] A more well-known classification in spine surgery is the Spine Adverse Events Severity System (SAVES) developed by Rampersaud *et al*.[27,28] The SAVES-Version 2 contains 15 intraoperative categories and 23 postoperative categories and delineates each complication into one of six severity grades.[29] Although this classification is comprehensive, it is not solely based on intervention severity. Grade 5 severity, for example, denotes significant neural injury, serious life- or limb-threatening event, or any sentinel event.[29] In contrast, the severity assessment scale utilized in our study and the ISSG-AO system is simple and is uniquely based on complication intervention.

Recent data has shown the ISSG-AO Adult Spinal Deformity Complications Classification System is reliable and reproducible.[10,13] Although this study was not intended to compare specific complication classification systems, an important difference between previous classification systems, such as Clavien-Dindo and SAVES and the ISSG-AO system, is that the ISSG-AO system was designed specifically for capturing and classifying complications in ASD. In contrast, the Clavien-Dindo system was developed for general surgery, and the SAVES is not specific to ASD. Furthermore, unlike other systems, the ISSG-AO system specifically accounts for complication resolution, and previous work has shown that health-related quality of life measures (HRQL) at 2 years were most affected by the total number of complications, complication resolution, and intervention severity.[21] Future studies should prospectively evaluate and compare the efficacy of each classification system in capturing complications among ASD patients, and each system's subsequent ability to predict complication impacts on patient outcomes.

This study has important limitations. First, this is a retrospective review, and therefore bears the limitations of a retrospective study design. For example, management of patients' ASD, as well as complication management, was potentially influenced by surgeon preference, shared decision making with patients, and local practices for complication management that may have differed between each institution, and may have impacted results. Secondly, although we assessed the impact of complications on LOS, we were not able to assess complication impacts on other potentially important outcomes, including long-term function, disability, and costs. Despite these limitations, important strengths of the study include its multicenter design and large patient population, which increase generalizability, and use of two separate multivariate regression models, increasing the reliability of our analysis.

In summary, surgical factors and complication intervention severity are significantly associated with LOS among patients undergoing surgery for ASD. For those experiencing a complication during their initial hospitalization, surgical factors that affected LOS included length of posterior spinal fusion, use of major osteotomy, or need for staged surgery. Increased invasiveness of complication intervention was identified by a novel complication severity assessment scale as the only non-surgical factor that independently predicted increased hospital LOS following ASD surgery. Modification of surgical factors may help reduce LOS, while classification of complication intervention severity may help surgeons

better understand and predict the impact of complications.

➢ Key Points

- ❑ Surgical treatment for ASD can improve patients' quality of life, but is associated with high rates of complications, which can impact outcomes and quality metrics, such as LOS.
- ❑ A recently developed ASD complication classification system includes grading of intervention severity for complications.
- ❑ Increasing severity of interventions for complications was independently associated with increased hospital LOS.
- ❑ Surgical factors, including posterior fusion, use of major osteotomy, and staged surgery, were also significantly associated with hospital LOS.
- ❑ Classifying ASD complications by intervention severity may help surgeons better understand and predict the implications of complications.

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