Practical answers to frequently asked questions for shared decision-making in adult spinal deformity surgery

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OBJECTIVE The shared decision-making (SDM) process provides an opportunity to answer frequently asked questions (FAQs). The authors aimed to present a concise list of answers to FAQs to aid in SDM for adult spinal deformity (ASD) surgery.

METHODS From a prospective, multicenter ASD database, patients enrolled between 2008 and 2016 who underwent fusions of 5 or more levels with a minimum 2-year follow-up were included. All deformity types were included to provide general applicability. The authors compiled a list of FAQs from patients undergoing ASD surgery and used a retrospective analysis to provide answers. All responses are reported as either the means or the proportions reaching the minimal clinically important difference at the 2-year follow-up interval.

RESULTS Of 689 patients with ASD who were eligible for 2-year follow-up, 521 (76%) had health-related quality-of-life scores available at the time of that follow-up. The mean age at the initial surgery was 58.2 years, and 78% of patients were female. The majority (73%) underwent surgery with a posterior-only approach. The mean number of fused levels was 12.2. Revision surgery accounted for 48% of patients. The authors answered 12 FAQs as follows:

1. Will my pain improve? Back and leg pain will both be reduced by approximately 50%.
2. Will my activity level improve? Approximately 65% of patients feel improvement in their activity level.
3. Will I feel better about myself? More than 70% of patients feel improvement in their appearance.
4. Is there a chance I will get worse? 4.1% feel worse at 2 years postoperatively.
5. What is the likelihood I will have a complication? 67.8% will have a major or minor complication, with 47.8% having a major complication.
6. Will I need another surgery? 25.0% will have a reoperation within 2 years.
7. Will I regret having surgery? 6.5% would not choose the same treatment.
8. Will I get a blood transfusion? 73.7% require a blood transfusion.
9. How long will I stay in the hospital? You need to stay 8.1 days on average.
10. Will I have to go to the ICU? 76.0% will have to go to the ICU.

ABBREVIATIONS AP = anteroposterior; ASD = adult spinal deformity; FAQs = frequently asked questions; HRQOL = health-related quality of life; LOS = length of hospital stay; MCID = minimal clinically important difference; NRS = numeric rating scale; ODI = Oswestry Disability Index; PCS = physical component summary; SDM = shared decision-making; SF-36 = 36-Item Short Form Health Survey; SRS-22r = 22-Item Scoliosis Research Society questionnaire; 3CO = 3-column osteotomy.


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SHARED decision-making (SDM) is gaining momentum in the current era of patient-centered care. SDM is defined as a process in which patients and physicians mutually engage to determine the best treatment. SDM improves patient satisfaction and quality of life, and reduces decisional conflict and patients’ anxiety. SDM is particularly important when there are no obvious “best” treatment options. This is typically the case for adult spinal deformity (ASD), because a gold standard has not been established in the management of this disease. Furthermore, surgical treatment for ASD is technically challenging, and complication and revision rates as high as 70% and 28%, respectively, have been reported. SDM takes into account evidence-based knowledge in addition to patients’ values and preferences. Physicians have a responsibility to provide appropriate information for patients to make a decision during the preoperative counseling process. Patients with insufficient comprehension may be more dissatisfied if adverse events occur. Considering the complex nature of ASD, it is expected that patients undergoing ASD surgery have a lot of questions preoperatively, and most of the questions are relatively common. The purpose of this study was to present a concise list of answers to these frequently asked questions (FAQs) to aid the SDM process during the surgical counseling in patients with ASD. In this study, we intentionally used and analyzed a large, heterogeneous ASD population to provide generalized answers for SDM counseling.

Methods

Subjects

From a prospective, multicenter ASD database, patients enrolled between 2008 and 2016 who underwent fusions of 5 or more levels with a minimum 2-year follow-up were included. ASD was defined as a coronal Cobb angle $\geq 20^\circ$, sagittal vertical axis $\geq 5$ cm, pelvic tilt $\geq 25^\circ$, and thoracic kyphosis $\geq 60^\circ$. We included all deformity types secondary to neuromuscular disorders, connective tissue or autoimmune diseases, infection, malignancy, or trauma were excluded.

FAQs

We compiled a list of FAQs from patients undergoing ASD surgery and used a retrospective analysis to provide answers. The top 12 FAQs were selected by an expert panel of fellowship-trained deformity surgeons (Table 1). All responses are reported as either the means or the proportion of patients reaching minimal clinically important differences (MCIDs) at the 2-year follow-up.

Data Collection

Demographic data, including age, sex, BMI, height, weight, and history of prior spine surgery, were recorded. Surgical and perioperative data collected included approach (anterior, posterior, or combined), number of levels fused, performance and type of osteotomies, units of blood transfused, length of ICU stay, and length of hospital stay (LOS). A complication was classified as major or minor as previously described. Back pain and leg pain were evaluated using a numeric rating scale (NRS). Health-related quality-of-life (HRQOL) outcome measures including the Oswestry Disability Index (ODI), 36-Item Short Form Health Survey (SF-36), and 22-Item Scoliosis Research Society questionnaire (SRS-22r) were collected.

Statistical Analysis

Differences between two independent groups were analyzed using the Fisher exact probability test or Mann-Whitney U-test depending on the variable type. The Wilcoxon rank-sum test was used to compare pre- and postoperative mean values (mean $\pm$ SD) in the same group. All version statistical analyses were performed using SPSS Statistics version 25 (IBM Corp.). Statistical significance was defined as a p value $< 0.05$.

Results

Patient Demographics

Of 689 patients with ASD who were eligible for 2-year follow-up, 521 (76%) had HRQOL scores available at the time of the 2-year follow-up. The demographic and surgical data are shown in Table 2. The mean age at the initial surgery was 58.2 years, and 78% were female. The majority (73%) underwent surgery with a posterior-only approach. The mean number of levels fused was 12.2. Revision surgery accounted for 48% of the study population.

Answers to the FAQs

FAQ 1: Will My Pain Improve?

We evaluated back and leg pain using an NRS (0 to 10). Back and leg pain were both reduced by approximately 50% at 2 years postoperatively (Fig. 1). Sixty-seven percent and 47% of patients reached an MCID of $-2$ points in back and leg pain, respectively. The mean preoperative back pain was $7.2 \pm 2.3$ and improved to $3.7 \pm 3.1$ at 2 years postoperatively ($p < 0.001$). The mean preoperative...
leg pain was 4.7 ± 3.4 and improved to 2.6 ± 2.9 at 2 years postoperatively (p < 0.001). Improvements in both back and leg pain reached a plateau at 6 months postoperatively.

FAQ 2: Will My Activity Level Improve?

To calculate activity score, we used questions 5, 9, 12, 15, and 18 from the SRS-22r questionnaire. The SRS-22r is a scoliosis-specific HRQOL questionnaire with 22 items and 5 domains: pain, appearance, activity, mental, and satisfaction. The activity domain score is an average value of the 5 questions, ranging from 1 to 5, with higher scores indicating better outcomes. The baseline SRS-22r activity score was 2.9 ± 0.9 and improved to 3.5 ± 1.0 at 2 years postoperatively (p < 0.001). Activity level improvement plateaued at 1 year postoperatively. Sixty-four percent of patients reached MCID for the SRS-22r activity at 2 years postoperatively (Fig. 2).

FAQ 3: Will I Feel Better About Myself?

We used questions 4, 6, 10, 14, and 19 from the SRS-22r questionnaire to calculate the appearance domain score. The appearance domain score is an average value of the 5 questions, ranging from 1 to 5, with higher scores indicating better outcomes. Improvements in SRS-22r appearance score were seen earlier than improvements in the activity score. Two-thirds (61.1%) of patients felt improvement in their appearance at 6 weeks postoperatively. Improvement reached a plateau at 6 months postoperatively. At 2 years postoperatively 71.2% reached MCID for the SRS-22r appearance domain (Fig. 2).

FAQ 4: Is There a Chance I Will Get Worse?

Four percent of patients had worsening of their ODI score, and 8.5% had worsening of the physical component summary (PCS) of the SF-36. The results from the both questionnaires indicated that the majority felt better, with approximately 50% reaching the MCIDs for both the ODI and the PCS from SF-36 (Fig. 3).

FAQ 5: What Is the Likelihood I Will Have a Complication?

Of the patients included, 67.8% had at least one complication and 47.8% had at least one major complication. Some patients had multiple complications at different time periods. In total, we identified 672 complications including 391 major complications. The majority of complications occurred after 90 days postoperatively (Fig. 4). The most common complications after 90 days were implant-related or radiographic complications (84%) such as rod breakage, pseudarthrosis, and proximal junctional kyphosis.

FAQ 6: Will I Need Another Surgery?

In total, 130 patients (25.0%) required at least one reoperation, which includes all types of reoperation, within 2 years (Fig. 5). The majority (60.8%) of reoperations were performed 90 days after the index surgery.

FAQ 7: Will I Regret Having Surgery?

We used question 22 from the SRS-22r questionnaire, “Would you have the same management again if you had the same condition?” Of the respondents, 6.5% would not choose the same treatment: they answered “probably not” or “definitely not”; 10.6% of patients answered “not sure”; and the rest (82.9%) chose “probably yes” or “definitely yes.”

FAQ 8: Will I Get a Blood Transfusion?

Three-quarters (73.7%) of patients received a blood transfusion. The median number of units transfused was 3. The rate of blood transfusion in the revision surgeries was 81%, which is significantly higher than that in primary surgeries (67%) (p < 0.001). The rate of blood transfusion in the anteroposterior (AP) combined approach was 69% and was significantly lower than that in the posterior-only approach (77%) (p < 0.001). The rate of blood transfusion in patients undergoing a 3-column osteotomy (3CO) was 86% and was significantly higher than that without 3CO (70%) (p < 0.001) (Fig. 6A).

FAQ 9: How Long Will I Stay in the Hospital?

The mean LOS was 8.1 ± 4.5 days. The LOS in the revision surgeries was 8.7 ± 4.9 days, which is significantly longer than that in primary surgeries (7.5 ± 3.9 days) (p = 0.003). The LOS in the AP combined approach was 9.6 ± 5.2 days and was significantly longer than that in the posterior-only approach (7.6 ± 4.1 days) (p < 0.001). The
LOS in patients undergoing a 3CO was 9.1 ± 4.1 days and was significantly longer than that without 3CO (7.8 ± 4.5 days) (p = 0.005) (Fig. 6B).

FAQ 10: Will I Have to Go to the ICU?

The majority of patients (76.0%) required an ICU stay, with the mean number of days being 1.9.

FAQ 11: Will I Be Able to Return to Work?

The employed rate was calculated by the number of employed patients divided by the number of employed plus disabled patients. Retired or unemployed individuals were excluded from the calculation. The majority (72.8%) of patients were working at 1 year and the rate was maintained at 2 years postoperatively (Fig. 7). Among 187 patients who were working prior to surgery, 8 (4%) became disabled, 24 (13%) were retired, 12 (6%) were unemployed, and 125 (67%) returned to full-time work at 2 years postoperatively. Among 61 patients who were disabled prior to surgery, 34 (56%) were still disabled, 18 (30%) were
retired, 3 (5%) returned to full-time work at 2 years postoperatively, and 6 (10%) were lost to follow-up.

FAQ 12: Will I Be Taller After Surgery?

The mean preoperative height was 163.65 cm, becoming 164.74 cm at 2 years postoperatively (p < 0.001), representing a gain of 1.1 cm.

Discussion

ASD has become increasingly common due to the growing elderly population. ASD has a significant negative impact on an individual, with deterioration in HRQOL scores compared to generational norms, and society is negatively impacted as well, because the healthcare cost for managing ASD is high. Management of ASD is characterized by significant variability with few points of consensus. Surgical treatment for ASD is complex, with high complication and revision rates. Thus, using an overt SDM process during the surgical counseling in patients with ASD is of paramount importance, to allow patients to clearly understand the likely surgical outcomes as well as the complication/revision rate. A recent study showed that patients undergoing ASD surgery remember less than 50% of the surgical risks discussed preoperatively. Providing a list of FAQs and their answers may help improve patients’ understanding and satisfaction with both their decision to proceed with surgery and their outcomes. For this reason, we compiled a list of FAQs for ASD surgery from an expert panel who derived FAQs from patient interviews and provided the answers based on a retrospective analysis using a large-scale multicenter database (Table 3).

Patients seeking ASD surgery typically list pain relief as one of the main goals. In our cohort, back pain improved from 7.2 to 3.7 and leg pain improved from 4.7 to 2.6. This is consistent with previous reports. This result may encourage patients with significant pain to choose surgical treatment, because nonoperative treatment has limited efficacy for pain relief.

Activity level showed significant improvement. As many as 65% of patients reached the MCID for the SRS-22r activity at 1 year postoperatively, and it was maintained 2 years after surgery. Liu et al. reported that less than 40% of patients who received nonoperative treatment reached the MCID in the SRS-22r activity domain with 2-year follow-up despite the fact that their cohort had less baseline disability. Smith et al. compared clinical outcomes between operative and nonoperative treatment for patients with ASD and demonstrated that 61% of patients undergoing surgery reached MCID thresholds, whereas only 18.9% of patients receiving nonoperative treatment reached MCID thresholds at 1 year after treatment. Our findings also demonstrated that improvement occurred...
within 1 year. These data may help patients make a decision for surgery.

Improvement in appearance was recognized earlier than an improvement in activity. Improvement reached a plateau at 6 months postoperatively. More than 70% of patients reached the MCID for the SRS-22r appearance at 6 months postoperatively, and it was maintained at 2 years after surgery. Smith et al. showed that 73.4% of patients undergoing surgery reached MCID thresholds in appearance, whereas only 13.4% of patients receiving nonoperative treatment reached the MCID threshold at 1 year after treatment. Additionally, it has been reported that the primary driver for patient satisfaction after ASD surgery is improvement in self-appearance. This relationship makes sense clinically for pediatric deformity such as adolescent idiopathic scoliosis but has yet to be better explained in ASD. On average, patients’ height after surgery was 1.1 cm taller than it was preoperatively. This is probably due to the restoration of sagittal alignment and may be related to improvement in appearance.

A clear and concise discussion regarding complication and revision rates is one of the most important components of the preoperative SDM counseling process. Previously reported complication rates are vastly different, ranging from 8.4% to 95%. This may be because ASD is heterogeneous or because most of the previous studies were limited by retrospective designs, single-center cohorts, and a lack of rigorous data collection. There have been two large-scale studies about complications after ASD surgery. Smith et al. investigated 291 patients undergoing ASD surgery and found that 69.8% of patients had at least one complication; of these 469 complications, 262 (56%) were major. Daniels et al. analyzed 905 patients undergoing ASD surgery and found that the overall complication rate was 60.1%. These reports are consistent overall with our findings. The likelihood that a patient would have a complication was 67.8%, with 47.8% having at least one major complication in the present study. These studies used the same database as the present study. However, the present study includes a larger and more current version of the cohort.

It is notable that despite the high complication rate, with 47.8% having at least one major complication in the present study, only 4% of patients felt worse postoperatively. Several studies have shown that complications, even major ones, have limited impact on patient-reported outcomes at 1 and 2 years after surgery. Our evaluation for “worse” was based on HRQOL scores at 2 years postoperatively. Some major complications, such as deep wound infection, resolve completely with treatment, whereas other major complications, such as a spinal cord injury, are permanent. We speculate that most of the major complications were treatable, and thus the HRQOL scores were not affected at 2 years postoperatively.

In our study, the revision rate was 25%. Smith et al. investigated 291 patients undergoing ASD surgery and found that 28.2% required reoperation during the follow-up interval. Daniels et al. reported that reoperation was required in 30% of patients undergoing surgery between 2009 and 2012, but the rate decreased to 14.6% in patients undergoing surgery between 2013 and 2014. Despite high complication and revision rates, the rate of exacerbation after surgery was relatively low; only 4.1% had a worse postoperative compared with preoperative ODI score (Fig. 4). In addition, when questioned only 6.5% answered that they would not choose the same treatment, whereas as many as 82.9% answered that they would choose the same treatment.

The need for blood transfusion in ASD surgery de-
The blood transfusion rate is reported to be 25.9%–63.0% in ASD surgery. The risk factors for blood transfusion were a long fusion, posterior or combined AP approach, and osteotomy. Our cohort only includes patients undergoing fusions of 5 or more levels, and 23% underwent 3CO, which might be related to the higher rate of blood transfusion. An ICU stay was required in 76.0% in the current study, which also may be related to the longer fusion (12.2 levels) in our cohort.

There is a paucity of data on return to work after ASD surgery even though it may be another important factor when making a decision to proceed with surgery. Excluding unemployed and retired patients, 75.4% of the cohort was employed and 24.6% was disabled before surgery. Of the cohort studied, 72.8% of patients were able to work 1 year after surgery and the rate was maintained 2 years after surgery. Sixty-one patients were disabled before surgery, of whom 34 patients were still disabled 2 years after surgery, 3 patients were able to return to work, 18 patients were retired, and 6 were lost to follow-up. It is noteworthy that patients who were disabled before surgery are unlikely to return to work after surgery, although the overall employment rate was high 2 years postoperatively.

There are several limitations in this study. First, ASD includes heterogeneous conditions such as idiopathic scoliosis, de novo scoliosis, iatrogenic malalignment, sagittal malalignment, and kyphosis. We included all types of spinal deformity. The results are probably specific to the deformity types and exact procedure. However, including all deformity types allows us to provide general applicability. Daniels et al. compared a complication rate from 2009 to 2016 across years and found that the complication rate decreased along with evolution of surgical treatment.

**FIG. 6.** Comparison of rate of blood transfusion (A) and LOS (B). Primary versus revision surgery, surgery with versus without 3CO, and posterior versus combined AP approach. *p < 0.05. Figure is available in color online only.
Finally, we discussed complication and revision rates in patients with 2 years of follow-up. Future work is needed to see long-term complication and revision rates.

**Conclusions**

This concise list of practical answers to 12 FAQs encountered in the SDM process while counseling patients for ASD surgery should aid both surgeons and patients.

**References**


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Disclosures

Dr. Ames is an employee of UCSF; receives royalties from Stryker, Biomet Zimmer Spine, DePuy Synthes, NuVasive, Next Orthosurgical, K2M, and Medtronic; is a consultant for DePuy Synthes, Medtronic, Medtronic, and K2M; conducts research for Titan Spine, DePuy Synthes, and the International Spine Study Group (ISSG); is on the Editorial Board of Operative Neurosurgery; receives grant funding from SRS; is on the Executive Committee of ISSG; and is a Director at Global Spinal Analytics. Dr. Bess is a consultant for Stryker and Mirus; has direct stock ownership in Progenitive Medicine and Karlsmed; is a patent holder with K2M; receives clinical or research support for the study described (includes equipment or material) from DePuy Synthes, Stryker, and NuVasive; receives support of non–study-related clinical or research effort that he oversees from DePuy Spine, Medtronic, Globus, SI Bone, Orthofix, and ISSG Foundation; and receives royalties from Stryker Spine and NuVasive. Dr. Burton has an ownership interest in Progenitive Medical; is a consultant for DePuy; and receives clinical or research support for the study described (includes equipment or material) from DePuy and Pfizer. Dr. Carreon is an employee of Norton Healthcare and the University of Southern Denmark; is a consultant for National Spine Health Foundation; and receives support of non–study-related clinical or research effort that she oversees from OREF, NIH, ISSG, SRS, TSRH, Pfizer, Lifesciences Corp., Intellirod, Cerapedics, Medtronic, Empirical Spine, and the NeuroPoint Alliance. She is also a member of the Editorial Advisory Board for Spine Deformity, The Spine Journal, and Spine; and is a member of the University of Louisville’s IRB. Dr. Daniels is a consultant for Spineart, Stryker, Orthofix, Medtronic, EOS, Southern Spine, Springer, and Medtricore. Dr. Gum is an employee of Norton Healthcare; is a consultant for Medtronic, DePuy, K2M/Stryker, Acuity, PacMed, and NuVasive; receives clinical or research support for the study described (includes equipment or materials) from Intellirod, Integra, Pfizer, and ISSG; has direct stock ownership in Cingulare Therapeutics; is a patent holder with Medtronic; and receives royalties from Acuity. Dr. Kim receives royalties from Zimmer Biomet and K2M-Stryker; and is a consultant for Alphatec. Dr. Klineberg
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