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Development of a Preoperative Predictive Model for Reaching the Oswestry Disability Index Minimal Clinically Important Difference for Adult Spinal Deformity Patients

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Abstract

Study Design: Retrospective review of prospective multicenter adult spinal deformity (ASD) database.
Objective: To create a model based on baseline demographic, radiographic, health-related quality of life (HRQOL), and surgical factors that can predict patients meeting the Oswestry Disability Index (ODI) minimal clinically important difference (MCID) at the two-year postoperative follow-up.
Summary of Background Data: Surgical correction of ASD can result in significant improvement in disability as measured by ODI, with the goal of reaching at least one MCID. However, a predictive model for reaching MCID following ASD correction does not exist.
Methods: ASD patients ⩾18 years and baseline ODI ⩾ 30 were included. Initial training of the model comprised forty-three variables including demographic data, comorbidities, modifiable surgical variables, baseline HRQOL, and coronal/sagittal radiographic parameters. Patients were grouped by whether or not they reached at least one ODI MCID at two-year follow-up. Decision trees were constructed using the C5.0 algorithm with five different bootstrapped models. Internal validation was accomplished via a 70:30 data split for training and testing each model, respectively. Final predictions from the models were chosen by voting with random selection for tied votes. Overall accuracy, and the area under a receiver operating characteristic curve (AUC) were calculated.
Results: 198 patients were included (MCID: 109, No-MCID: 89). Overall model accuracy was 86.0%, with an AUC of 0.94. The top 11 predictors of reaching MCID were gender, Scoliosis Research Society (SRS) activity subscore, back pain, sagittal vertical axis (SVA), pelvic incidence−lumbar lordosis mismatch (PI-LL), primary version revision, T1 spinopelvic inclination angle (T1SPI), American Society of Anesthesiologists (ASA) grade, T1 pelvic angle (T1PA), SRS pain, SRS total.
Conclusions: A successful model was built predicting ODI MCID. Most important predictors were not modifiable surgical parameters, indicating that baseline clinical and radiographic status is a critical factor for reaching ODI MCID.
Level of Evidence: Level II.

Keywords: Adult spinal deformity; Oswestry Disability Index; Minimum clinically important difference; Scoliosis; Predictive modeling

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IRB statement: All patients were enrolled into a protocol for which each site had obtained institutional review board approval.

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Introduction

Adult patients with spinal deformity (ASD) generally present with back and leg pain, neurologic symptoms (leg weakness and/or numbness), and functional limitations (difficulty standing upright, and exercise or ambulation intolerance) [1-11]. Several studies demonstrate significant relief of pain and improved function in a select group of patients with ASD that undergo operative treatment compared to non-operative treatments, including a higher likelihood of reaching a minimum clinically important difference (MCID) [9-19]. Given that ASD surgery is associated with a high complication rate [20-26], it is critical to assess patient reported outcomes in the context of a clinically applicable difference.

Clinical improvement following ASD surgery can be evaluated with changes in common patient reported outcomes scores such as the Oswestry Disability Index (ODI) [27], the Scoliosis Research Society questionnaire (SRS) [28-30], and the Medical Outcomes Short Form-36 (SF36) [31]. However, statistically significant differences in the above outcome metrics may be achieved postoperatively, yet the clinical implications of that difference may remain unknown. The MCID of an outcomes score attempts to define the minimum difference that is clinically meaningful to the patient [32,33]. This definition can aid in identifying the patients that had a clinically significant improvement in their outcome score and MCID values have been previously established [30,34,35] .

Recent attempts have been made to characterize the patients that will have the ‘‘best’’ or ‘‘worst’’ outcome following ASD surgery [16]. Smith and colleagues investigated 227 patients with ASD who underwent surgery and identified factors associated with the best (final Oswestry Disability Index [ODI] $\leqslant$15) or worst (final ODI $\geqslant$50) outcomes. The authors found that patients with the worst outcome had lower baseline ODI and Scoliosis Research Society (SRS)-22r scores, more back pain, greater body mass index (BMI), higher prevalence of depression, and higher prevalence of positive sagittal malalignment than the patients in the best group. Although this study provides valuable insight into which factors are associated with successful surgery, it does not provide a useable model to predict patients’ outcome a priori. Such a model can be very beneficial to both the surgeon and the patient. Surgical decision making could involve a predictive model that is deployed at the point of care setting and in real time generate the probabilities of success (MCID), complication rates, length of hospital stay, and potential costs to name a few possibilities. This information would be patient-specific and could influence what surgery is best suited for an individual patient; it could even provide a better discussion for shared decision making. For the surgeon, prior to surgery, the surgeon may identify risk factors that could be used to optimize a surgical plan that will result in a higher success rate of surgery and a complication rate that is low and acceptable to both the surgeon and patient. Predictive modeling could also be used to determine the extent of an operation that may be best suited for an individual patient taking onto account the patient-specific factors. Therefore, the goal of this study was to create a preoperative predictive model from baseline demographic, radiographic, health-related quality of life (HRQOL), and surgical factors that can predict the likelihood that a patient will have the best outcome as defined by meeting the ODI MCID at the two-year postoperative time point.

Materials and Methods

Patient Population

This study is a retrospective review of a prospective multicenter ASD database, which is contributed to by 11 sites across the United States. All patients were enrolled into a protocol for which each site had obtained institutional review board approval. Inclusion criteria for the database were as follows: age >18 years and presence of spinal deformity, as defined by scoliosis Cobb angle $\geqslant 20^{\circ}$, sagittal vertical axis (SVA) $\geqslant 5$ cm, pelvic tilt (PT) $\geqslant 25^{\circ}$, and/or thoracic kyphosis (TK) $\geqslant 60^{\circ}$. Exclusion criteria included spinal deformity of a neuromuscular etiology and presence of active infection or malignancy. In addition to the above database inclusion criteria, for the present study, patients were only included if they had a preoperative ODI score $\geqslant 30$, in order to minimize the floor effect and sufficiently allow for them to meet the ODI MCID of -15 points [16].

Data Collection, Radiographic Assessment, and HRQOL

The demographic and clinical data collected included patient age, gender, body mass index (BMI), race, number and type of comorbidities, and Charlson Comorbidity Index (CCI) [36]. Surgical data collected included American Society of Anesthesiologists (ASA) physical status classification, whether the surgery was a primary or revision procedure, the presence of a three-column osteotomy (pedicle subtraction osteotomy or vertebral column resection), the uppermost instrumented vertebra (UIV), the lower-most instrumented vertebra (LIV), and the number of posterior levels fused. The presence of (yes/no) and the number of levels were also collected for the following: direct decompression Smith-Petersen osteotomies (SPO) and interbody fusion (IBF).

Standardized HRQOL measures included the ODI, Short Form−36 (SF-36), and Scoliosis Research Society−22r (SRS-22r). Two standard summary scores were calculated based on the SF-36, the Physical Component Summary (PCS), and the Mental Component Summary (MCS). The SRS-22r provides a total score and multiple subdomains, including activity, pain, appearance, mental, and satisfaction. A numeric rating scale (NRS) score ranging from 0 (no pain) to 10 (most unbearable pain) was collected for back and leg pain separately.

Full-length free-standing lateral spine radiographs (36-inch cassette) at baseline were analyzed using a validated software [37-39] (Spineview, ENSAM, Laboratory of Biomechanics, Paris, France). All radiographic measures were performed at a central location based on standard techniques [38] and included the following: coronal Cobb angles of thoracic and lumbar curves, coronal plumbline, thoracic kyphosis (TK, T4−T12; Cobb angle between superior endplate of T2 and inferior endplate of T12), lumbar lordosis (LL, Cobb angle between superior endplate of L1 and superior endplate of S1), SVA (C7 plumbline relative to S1), pelvic tilt (PT), T1 spinal inclination (T1SPI), T1 pelvic angle (T1PA), and the mismatch between pelvic incidence and lumbar lordosis (PI-LL). The SRS-Schwab coronal curve type was determined for all patients [14].

Statistics and Predictive Model Construction

Only preoperative and baseline data were included in the model as the goal was to create a preoperative model to aid in point-of-care decision making. Continuous variables were described with the mean and standard deviation. Baseline variables were compared between the groups. Normality of data was determined using the Shapiro-Wilk test. Comparison of baseline means between the groups initially included an analysis of variance (ANOVA) or Kruskal-Wallis test when appropriate, which was followed by pairwise comparisons using Tukey's honestly significant difference test to control for type I error or Wilcoxon summed ranked tests where appropriate. Frequency analyses for categorical variables were conducted via Pearson χ^2 analysis. All statistical analyses were conducted using commercially available software (SPSS v22, IBM, Armonk, NY) and the level of significance was set at $p < .05$ for all tests.

For the predictive model, missing values within the database were imputed using standard techniques such as mean and median imputation [40]. Once a complete data set was constructed, a supervised ensemble of decision trees was constructed with the target variable being binary, which included (1) patients who had reached or exceeded the MCID for ODI (MCID) or (0) not reaching MCID for ODI at 2 years postoperatively (No-MCID). The decision tree algorithm was C5.0, and five different bootstrapped models were built [40]. Internal validation was accomplished via a 70:30 data split for training and testing the model, respectively [40]. Final overall predictions from the models were combined and chosen by voting with random selection for tied votes. Overall accuracy, and the area under a receiver operating characteristic curve (AUC) were calculated. The model was built using commercially available software (SPSS Modeler v16, IBM, Armonk, NY).

Results

Patient Population and Demographics

There were 365 eligible patients, 267 (73.2%) had complete baseline studies and two-year follow-up. Of those, a total of 198 (74.2%) patients met the additional inclusion criterion of a baseline ODI $\geqslant 30$. There were 109 (55.1%) targets as defined above, and 89 (45.9%) patients that did not reach MCID for ODI at the two-year follow-up. There were 165 (83.3%) women and 33 (16.7%) men, and the mean age was 60.2 ± 12.1 years with a mean BMI of 28.3 ± 6 (Table 1). There was a significantly higher proportion of women in the MCID group than the No-MCID

Table 1
Summary of demographic characteristics.

	All patients	MCID	No-MCID	p value
Number	198	109	89	
Age, M ± SD	60.2 ± 12.1	59.5 ± 12.2	60.9 ± 12	.5630
Female/male	165 (83.3%)/33 (16.7%)	**97 (89.0%)/12 (11.0%)**	**68 (76.4%)/21 (23.6%)**	**.0181***
Race				
Asian	2 (1%)	2 (1.9%)	0 (0%)	.6668
Back	12 (6.2%)	6 (5.6%)	6 (6.9%)	
Hispanic	4 (2.1%)	2 (1.9%)	2 (2.3%)	
White	177 (90.8%)	98 (90.7%)	79 (90.8%)	
Other	3 (1.5%)	1 (0.9%)	2 (2.2%)	
BMI, M ± SD	28.3 ± 6	27.9 ± 6.4	28.7 ± 5.5	.1829
CCI, M ± SD	1.7 ± 1.7	1.7 ± 1.6	1.8 ± 1.8	.8893
Min 1 comorbidity, n (%, range)	154 (77.8%, 1–9)	85 (78%, 1–9)	69 (77.5%, 1–7)	.9391
Arthritis	81 (40.9%)	47 (43.1%)	34 (38.2%)	.4839
Osteoporosis	25 (12.6%)	13 (11.9%)	12 (13.5%)	.7429
Depression	60 (30.3%)	35 (32.1%)	25 (28.1%)	.5403
Smoker	16 (8.1%)	10 (9.2%)	6 (6.7%)	.5321
Preoperative SRS-Schwab coronal curve[†]				
Type N	71 (35.9%)	37 (33.9%)	34 (38.2%)	.4325
Type T	7 (3.5%)	5 (4.6%)	2 (2.2%)	
Type L	76 (38.4%)	39 (35.8%)	37 (41.6%)	
Type D	44 (22.2%)	28 (25.7%)	16 (18%)	

BMI, body mass index; CCI, Charlson Comorbidity Index; MCID, minimal clinically important difference.

Values are n (%) unless otherwise noted. Means and ±1 standard deviation for the demographics of all the patients as well as each group. Values in bold marked with asterisk represent a statistically significant difference between the MCID and No-MCID groups.

[†] The different types of SRS-Schwab coronal curve types are presented in the methods section.

group (89.0% vs. 76.4%, respectively, $p < .05$, Table 1). All other demographic variables were similar between the groups ($p > .05$ for all, Table 1).

Surgical Data

The MCID group had a higher proportion of patients undergoing primary surgery (69.7%), as compared to the No-MCID group (55.1%, $p < .05$, Table 2). Both groups had similar proportions of patients who underwent a direct decompression, an SPO, a 3-column osteotomy, and an IBF ($p > .05$ for all, Table 2). Similarly, the groups did not differ in mean number of posterior levels fused, decompression levels, SPO levels, and IBF levels ($p > .05$ for all, Table 2).

Preoperative Radiographic Data

The MCID group had significantly lower mean baseline PI-LL, SVA, and T1SPI than the No-MCID group ($p < .05$ for all, Table 3). Both groups had statistically similar baseline mean coronal plumbline, PT, TK, T1PA and proportion of patients in the three different maximum coronal Cobb angle groups ($p > .05$ for all, Table 3).

Preoperative HRQOL data

The MCID group had significantly higher baseline mean SRS Activity score, and a significantly lower back pain score ($p < .05$ for both, Table 4). All other HRQOL were

Table 2
Summary of surgical variables for all patients, MCID group and NO-MCID group.

Surgical data	All patients	MCID	No-MCID	p value
Number	198	109	89	
Primary/revision	125 (63.1%)/73 (36.9%)	**76 (69.7%)/33 (30.3%)**	**49 (55.1%)/40 (44.9%)**	**.0333***
Mean number posterior levels fused	11.2 ± 4.6	11.3 ± 4.6	10.9 ± 4.6	.4373
Decompression (% patients of total)	133 (47.5%)	76 (48.6%)	57 (46.1%)	.3972
Mean number decompression levels	1.8 ± 1.9	2 ± 2	1.6 ± 1.6	.2079
Smith-Petersen osteotomy (% patients of total)	94 (23.7%)	53 (19.3%)	41 (29.2%)	.7201
Mean number SPO levels	2.3 ± 2.8	2.5 ± 3	2.1 ± 2.6	.5415
Three-column osteotomy (% patients of total)	47 (69.7%)	21 (69.7%)	26 (69.7%)	.1017
Interbody fusion (% patients of total)	138 (0%)	76 (0%)	62 (0%)	.9925
Mean number of IBF levels	1.7 ± 1.8	1.7 ± 1.7	1.8 ± 1.9	.9082

IBF, interbody fusion; MCID, minimal clinically important difference; SPO, Smith-Petersen osteotomy.

The number and the corresponding percentage for each surgical variable category: all the patients, MCID group, and the No-MCID group. Values in bold marked with asterisk represent a statistically significant difference between the MCID and No-MCID groups.

Table 3
Summary of radiographic parameters for all patients, MCID and No-MCID groups (mean ± 1 standard deviation).

	All patients	MCID	No-MCID	p value
Coronal PL (mm)	35.1 ± 33.5	35 ± 36.7	35.2 ± 29.4	.4530
PT	25.6 ± 10.8	24.7 ± 10.9	26.6 ± 10.6	.213
PI-LL	19 ± 20.7	**16.1 ± 19.8**	**22.5 ± 21.4**	**.0430***
TK	33.7 ± 18.5	34.9 ± 19.1	32.2 ± 17.8	.3272
SVA (mm)	75.8 ± 77.6	**65.1 ± 79.5**	**89 ± 73.5**	**.0174***
T1SPI	−0.6 ± 6.6	**−1.5 ± 6.9**	**0.4 ± 6**	**.0099***
T1PA	24.8 ± 13.4	23.3 ± 13.3	26.7 ± 13.2	.0517
Max Cobb angle groups				
<30°	74 (37.4%)	37 (33.9%)	37 (41.6%)	.3365
30°–60°	87 (43.9%)	53 (48.6%)	34 (38.2%)	
>60°	37 (18.7%)	19 (17.4%)	18 (20.2%)	

MCID, minimal clinically important difference; PI-LL, mismatch between pelvic incidence (PI) and lumbar lordosis (LL); PT, pelvic tilt; SVA, sagittal vertical axis; TK, thoracic kyphosis; T1SPI, T1 spinopelvic inclination; T1PA, T1 pelvic angle.

Mean ± 1 standard deviation for the radiographic parameters for all patients, MCID and No-MCID groups. Values in bold marked with asterisk represent a statistically significant difference between the proximal junction kyphosis (PJK)/proximal junction failure (PJF) and NONE groups.

statistically similar between the groups ($p > .05$ for all, Table 4).

Model Results

The overall model accuracy was 86.0% correct with an AUC of 0.94, indicating a very good fit of the model. The top 11 predictors of reaching MCID are shown in Table 5 (importance ⩾0.90); in decreasing order of importance, the predictors were gender, SRS activity subscore, back pain, SVA, PI-LL, primary versus revision, T1SPI, ASA grade, T1PA, SRS pain, and SRS total.

Table 4
Preoperative HRQOL for all patients as well as those that reached minimally clinically important difference (MCID) for the Oswestry Disability Index (ODI) and those who did not (No-MCID).

Preoperative HRQOL	All patients	MCID	No-MCID	p value
ODI	51.4 ± 13.9	51.4 ± 14.2	51.3 ± 13.5	.8613
PCS	28.8 ± 6.6	29.1 ± 6.8	28.5 ± 6.4	.4078
MCS	42.5 ± 13.1	43.2 ± 14.1	41.8 ± 11.7	.4381
SRS Activity	2.6 ± 0.7	**2.7 ± 0.7**	**2.5 ± 0.7**	**.0237***
SRS Pain	2.1 ± 0.7	2.2 ± 0.7	2.1 ± 0.7	.068
SRS Appearance	2.2 ± 0.7	2.3 ± 0.7	2.2 ± 0.6	.5464
SRS Mental	3.2 ± 0.9	3.3 ± 0.9	3.1 ± 0.9	.2581
SRS Satisfaction	2.7 ± 1.1	2.7 ± 1.1	2.7 ± 1	.9718
SRS Total	2.6 ± 0.6	2.6 ± 0.6	2.5 ± 0.5	.0623
Back pain NRS	7.8 ± 1.8	**7.6 ± 2**	**8.1 ± 1.6**	**.0471***
Leg pain NRS	5 ± 3.1	5.2 ± 3.2	4.7 ± 2.9	.1870

HRQOL, health-related quality of life; MCS, Mental Component Score of the SF-36; MCID, minimal clinically important difference; NRS, numeric rating scale; PCS, Physical Component Score of the SF-36; SRS, Scoliosis Research Society-22 questionnaire.

Values in bold marked with asterisk represent a statistically significant difference between the MCID and No-MCID groups.

Table 5
Top 11 predictors numbered in order of decreasing importance within the list of the 43 variables used in the model.

Gender 1	Interbody fusion (yes/no)
SRS-Schwab Coronal curve type	Number of interbody fusion levels
Age	Maximum Cobb angle (<30°, 30°–60°, >60°)
BMI	Coronal C7 plumbline distance
Revision surgery (yes/no)—6	Pelvic tilt (PT)
At least 1 comorbidity (yes/no)	Mismatch between pelvic incidence and lumbar lordosis (PI-LL)—5
Number of comorbidities	Thoracic kyphosis (T2–T12)
Charlson comorbidity index	C7 sagittal vertical axis (SVA)—4
Race	T1 spinopelvic inclination (T1SPI)—7
Depression (yes/no)	T1 pelvic angle (T1PA)—9
Osteoporosis (yes/no)	Oswestry Disability Index (ODI)
Arthritis (yes/no)	Physical Component Score from SF-36 (PCS)
ASA grade—8	Mental Component Score from SF-36 (MCS)
Smoker (yes/no)	SRS Activity—2
Uppermost instrumented vertebra	SRS Pain—10
Lowermost instrumented vertebra	SRS Appearance
Number of posterior levels fused	SRS Mental
Decompression (yes/no)	SRS Satisfaction
Number of decompression levels	SRS Total—11
Smith-Petersen osteotomy (yes/no)	Back pain numerical rating scale—3
Number of Smith-Petersen osteotomies	Leg pain numerical rating scale

ASA, American Society of Anesthesiologists; BMI, body mass index; MCS, Mental Component Score of the SF-36; NRS, numerical rating scale; ODI, Oswestry Disability Index; PCS, Physical Component Score of the SF-36; PSO, pedicle subtraction osteotomy; SRS, Scoliosis Research Society-22 questionnaire; VCR, vertebral column resection.

Three-column osteotomy PSO/VCR (yes/no).

Discussion

In well-selected ASD patients, operative treatment can provide significant relief of pain and improve function [9-11,14-18]. Identifying these patients prior to the operation can be very difficult. Currently, predictive models do not exist for the surgeon to use as a guide to predict which patients may be the best overall surgical candidates. In the present study, we created a model from baseline demographic, radiographic, HRQOL, and surgical factors that predicted patients having the best outcome as defined by meeting the ODI MCID at the two-year postoperative follow-up. The accuracy of the overall model was 86.0% correct, with an AUC of 0.94. This model can set the groundwork for preoperative point-of-care decision making and improved patient counseling regarding expected outcomes of ASD surgery.

Interestingly, most of the important predictors were not surgically modifiable, suggesting that the baseline clinical and radiographic status of the patient is a critical factor for reaching ODI MCID. It is very important to note, however, that all 43 variables were included in the model. The 11 most important variables listed were the variables used

early in the decision tree for the major branch points. Therefore, the patients were initially split into large groups based on those variables. The surgical variables may play a more important role in select patient populations. These populations would be identified in the lower branches of the trees as the patients get split into smaller groups. There the surgical variables may play a larger role. It is important to note that all types of spinal deformity and types of surgery were included. Our goal was to create a tool that is generalizable and thus has the most use in point-of-care during decision making via mobile tablet or computer.

The details and rationale for the use of decision trees and predictive modeling in general are described elsewhere [23,41], but briefly, a few desirable properties of decision trees are as follows: 1) the ability to incorporate continuous and categorical data, 2) ease of construction, 3) the capacity to handle hundreds of variables, and 4) feasibility with missing data. Furthermore, five different decision trees were used to increase the accuracy of the model and the data was split into training and testing data sets (all bootstrapped) to increase the validity of the model. Thus, for the outcomes of reaching ODI MCID, this model strategy worked very well.

There are a couple of prior studies that employ similar predictive modeling techniques as the present study worth mentioning [2,42]. With 188 patients and 6 variables, Daubs and colleagues created an ensemble of 50 decision trees to investigated predictors of psychological distress for patients with a spinal disorder [2]. The final model was very accurate to 92% and was 92% sensitive and 95% specific [2]. This model is similar to the present study in that an ensemble of trees was used. This is a beneficial and very powerful technique, allowing for increased accuracy.

A chi-square Automatic Interaction Detection (CHAID) decision tree analysis was used by Spratt and colleagues to predict a successful outcome following lumbar stenosis decompression. Their model was 90.1% accurate, had a positive predictive value 85.7%, and a negative predictive value 100% [42]. Two major differences with their model and the present study was the use of just 32 patients and just one decision tree. In the present study, we were able to use predictive modeling techniques with ASD patients in order to predict which patients will have the best outcome as defined by meeting the ODI MCID. Given that the risk is quantified and individualized, it can be part of the initial patient-surgeon discussion. This method of identifying patients who are at the highest risk of having a poor outcome can allow for adequate preoperative preparation or prevention strategies.

One of the strengths of the current study is the data were derived from 11 different sites in the United States in which patients were enrolled by several surgeons; this allows for better generalizability of the results. Another strength of this study is the high quality of the data, which included a comprehensive preoperative and two-year follow-up of ASD patients. And lastly, the use of modern predictive analytics algorithms facilitated creation of an individualized and customized patient-centered model.

The study does have a few limitations, one of which includes the retrospective design that may have contributed to selection bias. Additionally, patients were included in the model if their baseline ODI was 30 or greater and, thus, this model does not apply to those with a lower baseline ODI. Another limitation is defining a ‘‘successful’’ surgical outcome as a decrease in ODI by at least one MCID value (−15 points for ODI). Obviously there are many other factors that contribute to a successful surgery. Indeed, the definition of ‘‘successful surgery’’ is the subject of considerable controversy because of the many perspectives and values that impact it. A more clinically robust predictive model would include multiple outcome targets. There remain many challenges with selection of the specific variables to include and, even more so, with establishing thresholds for success for those outcome variables. The present model is a starting point to introduce predictive modeling as well as begin the discussion and work into what constitutes successful surgery for ASD patients.

A successful model (86% accuracy, 0.94 AUC) was built predicting the likelihood of reaching the MCID threshold for ODI after ASD surgery. Most of the important predictors were not modifiable surgical parameters, indicating that the baseline clinical and radiographic status of the patient is a critical factor for reaching ODI MCID. This model can set the groundwork for preoperative point of care decision making, and improved patient counseling regarding expected outcomes of ASD surgery.

Key points

- A successful model (86.0% accuracy, AUC 0.94) was built predicting ODI MCID following ASD correction.
- The most important predictors were not modifiable surgical parameters, indicating that baseline clinical and radiographic status is a critical factor for reaching ODI MCID.
- This model can set the groundwork for preoperative point-of-care decision making, and improved patient counseling regarding expected outcomes of ASD surgery.

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