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Reviewer A

The is manuscript is of a five-year multicenter study of 722 Patients in which the authors have investigated the trends in outcomes and complications after robot-assisted spine surgery. According to the authors this is the first ever and largest multi-center study of its type. The surgeries were performed at 4 different centers by 7 different surgeons using three Mazor robotic systems at these centers.

The authors have done a good job with the manuscript. It is a well-designed study, and a well written manuscript. Their findings provide the reader with attractive and thorough inspection of the topic. However, I would like to know more about their control group. Was there a control group or the comparison is with the relevant information from the literature?

Reply: Thank you for your thoughtful comments. Our analysis aimed to demonstrate whether or not there were specific trends in outcomes (e.g. screw accuracy) and not to compare to a specific control group (e.g. freehand). In other words, this was not a comparative study so a control group was not needed.

Changes in text: N/A

How many cases of surgeries with conventional hand-guided (fluoroscopy-guided and CT-Guided) screw placement for spinal instrumentation at these centers does the control group have? I am assuming the comparison is with the surgeries performed at these centers before adding the Mazor robots to their armament. Additionally, the authors should share information about control group in the method section.

Reply: As mentioned above, this study was not a comparative study between conventional hand-guided screw placement and robots. All centers used the Mazor robotic systems (Renaissance, Mazor X, and Mazor Stealth). So only robot cases were collected from each institution. Our paper performed trends analyses to determine which outcomes, if any, improved over a 5-year period. To determine which covariates were significantly associated with the outcome of interest (e.g. screw accuracy, robot abandonment), we performed a multivariate regressions for each outcome.

Changes in text: See 'Patient Selection' section of Materials and Methods. Page 6, Lines 102-109: "In this multicenter study, we included adult (≥18 years old) patients who underwent robot-assisted spine surgery between 2015 and 2019 at four geographically diverse institutions (Columbia University, Virginia Spine Institute, University at Buffalo Neurosurgery, and University of Virginia Health System). The

robotic systems used included the Mazor Renaissance, Mazor X, and Mazor Stealth Edition. A minimum of 25 robot cases were performed per surgeon at each institution. Two institutions (of the four) included all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system."

Kindly cite the following article in discussion section accordingly.
Fiani B, Quadri SA, Ramakrishnan V, Berman B, Khan Y, Siddiqi J. Retrospective Review on Accuracy: A Pilot Study of Robotically Guided Thoracolumbar/Sacral Pedicle Screws Versus Fluoroscopy-Guided and Computerized Tomography Stealth-Guided Screws. Cureus. 2017 Jul 6;9(7):e1437.
Reply: Thank you for your suggestion. We have included this citation in our introduction as it is another great example that robot-assisted spine surgery can achieve comparable outcomes to conventional techniques. We did not include this reference in our discussion since we hope to focus on the trends in outcomes for robot-assisted spine surgery and not so much the comparison between robot-assisted and conventional techniques.
Changes in text: See 'Introduction' section of our manuscript. Page 5, Lines 89-91: "With the introduction of robot-assisted spine surgery nearly twenty years ago, literature suggests that robots are safe and can achieve comparable outcomes to conventional techniques[7, 9-12]."

The authors have done a good job compiling the relevant literature findings and deliver the reader with attractive insight on the topic. It was an interesting read and would recommend for publication after the abovementioned minor revisions.
Reply: Thank you for your review!
Changes in text: N/A

Reviewer B

The authors present a large data series measuring the total robot time, robot time per screw, and total fluoroscopy time per screw as well as the exchange of malpositioned screws and rate of abandonment of the screws. No comparison was made between robot-assisted vs freehand placement of pedicle screws. However, the data presented does suggest that robot-assisted spine surgery does have a reasonable complication rate and does not place patients at an unacceptable risk of complications during pedicle screw instrumentation,

Suggestions:

1. Instead of combining all pathologies (ie high grade spondylolisthesis, degenerative disc disease, etc) into one analysis group, it might be reasonable to consider evaluating these as separate independent variables for a few reasons. First, the authors note that there is a trend of increasing the frequency of robot-assistance in open cases, which may represent a higher utilization in deformity cases.
Reply: Thank you for your suggestions. We agree that it may be useful to subcategorize the analysis by indication for surgery. We have revised Table 1 to include the trend analysis for each subcategory indication for surgery. The utilization of robot for scoliosis did not change significantly over time. Instead, there was a decreasing trend for high grade spondylolisthesis and increasing trend for spinal stenosis.
Changes in text: See Table 1. See Results section of our manuscript. Page 9, Lines 181-184: "Although open surgery (vs. percutaneous) became more common over time, the rate of scoliosis surgery was not significantly different over time (P=0.631). Instead, there was an increase in spinal stenosis (P=0.004) and a decrease in high grade spondylolisthesis (P=0.002) (Table 1)."

Second, there is always a windup and breakdown time associated with robot use (a sunk time-cost) that would be the same for most procedures, but would be diluted if more levels are instrumented.
Reply: Thank you for this suggestion. We agree that this would be an important metric to consider especially when comparing long vs. short instrumented cases. In our study, the total number of instrumented levels did not change from year to year. This would be a useful variable to study in future studies, especially for cost-effective analyses.
Changes in text: N/A

Third, as many dependent variables are measured across time and the goal of the paper is to present a multicenter experience over 5 years, the case mix of robot-assisted cases may be as significant as surgeon experience and technology evolution.
Reply: This is an important point. We attempted to capture the "case-mix" by assessing for CCI, indication for surgery, and operative factors (e.g. # of instrumented levels, interbody fusion, pelvic fixation). We attempted to control for these factors by employing a multivariate analysis for our outcomes of interest. We have addended our methods. Surgeon experience and learning curve was not specifically studied in this study and we acknowledge this is a major limitation of our paper. We have included this point in the limitations section of our discussion. Thank you.
Changes in text: See 'Data Analysis' section of Materials and Methods. Page 8, Lines 163-167: "Trends were assessed using the Cochran-Armitage Test for categorical data. The Mann-Kendall Test (non-parametric) and linear regression

(parametric) continuous data. Generalized linear models were used to control for potential co-variates and to determine the potential independent risk factors for the outcomes of interest. Covariates with a P-value<0.2 were entered in our multivariate models. Statistical significance was defined as a P-value <0.05."
See 'Limitations' section of Discussion. Page 16, Lines 332-335: "The learning curve was not directly examined in this study, which may be a major limitation since both 3rd and 4th generation robots were introduced and employed by each site during the study's time period. Future prospective multicenter studies would be useful in further investigating the impact of surgeon experience on robot-assisted spine surgery outcomes."

Furthermore, this is a large dataset, which may allow for appropriate statistical analysis of the subgroups.
Reply: Thank you for your suggestions. We agree that it may be useful to subcategorize the analysis by indication for surgery. Furthermore, our primary objective was to determine what the trends in outcomes were with robot-assisted spine surgery. However, if we subcategorized our data by indication for surgery, the sample size may not be sufficient per year. We recognize the importance of this variable as well as other (e.g. open vs. percutaneous) surgery which is used our multivariate analysis to determine its impact on outcomes.
Changes in text: N/A

2. It seems that the length of stay would not be affected, unless there are revisions needed for mal-placed screws. Furthermore, as the authors indicate, there are multiple factors that are considered for discharge, including discharge destination. May consider not including this as a dependent variable. The suggestion that robotics can create cost-savings (presented in the Discussion and Conclusion) by decreasing the LOS is not supported by the authors' data. Furthermore, the case length is increased when using robot-assistance in open procedures, which is not cost neutral.
Reply: Thank you. We agree that our data does not directly support cost-effectiveness of robots. We have addended the limitations section of our Discussion.
Changes in text: See 'Limitations' section of our Discussion. Page 14-15, Lines 301-314: "There are a number of other limitations that should be considered for this study. First, the cost-effectiveness was not directly addressed in this study. Unfortunately, the current literature on this topic is sparse. Given the associated cost of Mazor X at $550,000, which includes installation and all hardware, it is estimated that ten to twelve lumbar surgeries are needed to pay back this initial cost[7, 40]. Menger et al conducted a large, retrospective study on 557 patients and concluded that the application of robotic spine surgery is cost effective, when considering the potential reductions in revision surgery, infections, operative time, and length of stay [41]. In our study, we demonstrate that operative efficacy has improved and total length of

hospital stay has reduced by nearly one day from 2015 to 2019 (P-Value=0.007, R^2 = 0.779), even though the mean CCI has increased from 0.95 to 1.7. In addition, the 90-day reoperation rates remain consistently low over time. Although the LOS decreased over the years, this was largely attributed to the increased percentage of patients being discharged from home versus rehab and not robot type. In order to validate the possibility that robot-assisted spine surgery can be cost-effective, future work on this topic, specifically analyzing cost parameters, are needed."

3. Variables such as time per screw are interesting to note, but ultimately are sensitive to many confounding factors. Furthermore, the clinical significance of this variable is not clearly outlined, especially when the general consensus is that use of a robot may increase the total duration of the surgery.
Reply: The clinical significance of improved robot time spent per screw is improved robot efficiency. We agree that the consensus from literature is that robot time per screw is likely longer than freehand. This is exactly why we sought to examine the robot time (not operative time) per screw and determine if there has been any reduction in time spent per screw. Our findings demonstrate we are improving and perhaps more efficiently using the robot. The major limitation, however, is that our multicenter study does not compare against a control group (e.g. freehand). We have acknowledged this in the limitations section of our Discussion.
Changes in text: See 'Limitations' section of Discussion. Page 15, Lines 316-320: "A multicentered comparison of trends with a conventional freehand cohort would be useful, particularly for comparing screw accuracy and time spent per screw by the same surgeons. Unfortunately, this data was not available as most surgeons in this cohort primarily used robot-assisted technology."

Reviewer C

The objective of this retrospective multicenter study (four institutions, seven surgeons, 3 different robotic systems) enrolling 722 patients was to describe the trends in outcomes and complications of robot-assisted spine surgery within a five-year period. The authors found a reduction of robot time per screw, mean fluoroscopy time, intraoperative screw misplacement, robot abandonment rate and the inpatient rate. In contrast, the incidence of other non-robot related complications remained low. The authors conclude that these findings support the continued usage of robotic assistance in spine surgery. Although the intention of the authors is reasonable and the data are good, the manuscript suffers from insufficient statistics and inadequate reporting of the results. Furthermore, it remains unclear which factors contribute to the improvement, e.g. learning curve of the surgeon, improvement of robotics, etc.

Notably, this is one of few studies including different robotic systems. In the present version, the manuscript is not of sufficient quality for publication. Major revision is necessary.
Layout and format: The manuscript is clearly structured and meets the expected format of the targeted journal.
Title: The title is too long. Additionally, it is not necessary to include both number of patients and screws. The range of data acquisition can be removed.
Reply: Thank you for this suggestion. We have addeneded our title.
Changes in text: See Title: "The 5-Year Trends in Outcomes and Complicaitons After Robot-Assisted Spine Surgery: A Multicenter Study of 722 Patients and 5,005 Screws"

Abstract: The abstract is well-structured and reflects the content of the article. However, it is not necessary to include the ethics statement in the abstract. "Patients with missing data were excluded from this study" is not necessary. Typo in line 43 ([… fixation, …]).
Reply: Thank you. This line has been removed.
Changes in text: See 'Methods' section of abstract.

Please define LOS.
Reply: Done. Thank you.
Changes in text: See 'Data Collection' of Methods. Page 6, Lines 120-121: "Outcomes of interest included operative efficiency (robot time per screw), radiation exposure (fluoroscopy time per screw), robot complications (e.g. screw exchange, robot abandonment), clinical outcomes (e.g. length of stay [LOS=days between date of discharge and date of admission], 90-day reoperations)"

Introduction: The introduction is well-written. It summarizes the current knowledge and describes the aim of the study. It would be worth to describe the basis of the hypothesis that there will be significant improvements, due to the surgeon's learning curve? Improvements of the robots?
Reply: Our hypothesis was that the improvements would, at least in part, be due to the improvements in robot-assisted technology.
Changes in text: See last paragraph of our Introduction. Page 5, Lines 96-98: "We hypothesize that the improvements in robot-assisted technology will contribute to significant improvements in robot screw accuracy, reliability, operative efficiency, and radiation exposure over time."

Methods and statistics: The problems of the manuscript start with the methods part. It remains unclear, which centers are involved, how many surgeons are included, when was the introduction of the robots in these centers.

Reply: The following institutions were involved: Columbia University, Virginia Spine Institute, University at Buffalo Neurosurgery, and University of Virginia Health System. Seven attending spine surgeons, each with a minimum of 25 robot spine cases were included in the study. Two institutions (of the four) included all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system.
Changes in text: See 'Patient Selection' of Materials and Methods (Page 6, Lines 102-109): "In this multicenter study, we included adult (≥18 years old) patients who underwent robot-assisted spine surgery between 2015 and 2019 at four geographically diverse institutions (Columbia University, Virginia Spine Institute, University at Buffalo Neurosurgery, and University of Virginia Health System). The robotic systems used included the Mazor Renaissance, Mazor X, and Mazor Stealth Edition. A minimum of 25 robot cases were performed per surgeon at each institution. Two institutions (of the four) included all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system."

Did all center apply all kind of robots? I expect, that each center had a different robot. There are only few centers with experience in different robotic systems so far.
Reply: As mentioned above, two institutions (of the four) included all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system.
Changes in text: See 'Patient Selection' of Materials and Methods. Page 6, Lines 102-109: "In this multicenter study, we included adult (≥18 years old) patients who underwent robot-assisted spine surgery between 2015 and 2019 at four geographically diverse institutions (Columbia University, Virginia Spine Institute, University at Buffalo Neurosurgery, and University of Virginia Health System). The robotic systems used included the Mazor Renaissance, Mazor X, and Mazor Stealth Edition. A minimum of 25 robot cases were performed per surgeon at each institution. Two institutions (of the four) included all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system."

Did the centers differ in the implantation technique beyond the used robot?
Reply: Thank you for your comment. Because this was a retrospective study, the implantation technique beyond the use of the robot was not able to be determined. This is a potential limitation of this study, particularly for determining the impact on total operative time. However, the majority of our outcomes of interest focused on the robot screw accuracy, robot time spent per screw, robot abandonment, and radiation exposure from robot use. Therefore, we believe that surgery beyond the use of the robot would be less relevant for our study.

Changes in text: N/A

The statistics are adequate, however, they are not well described, e.g. which covariates have been used for the generalized linear models? Which criteria were applied in the selection of the covariates?
Reply: We have addended our methods and results sections. Table 5 includes the co-variates that were included in the generalized linear model for each outcome of interest.
Changes in text: See 'Data Analysis' of Materials and Methods section. Page 8, Lines 163-168). "Trends were assessed using the Cochran-Armitage Test for categorical data. The Mann-Kendall Test (non-parametric) and linear regression (parametric) continuous data. Generalized linear models were used to control for potential co-variates and to determine the potential independent risk factors for the outcomes of interest. Covariates with a P-value<0.2 were entered in our multivariate models. Statistical significance was defined as a P-value <0.05." Table 5 includes the co-variates that were included in the generalized linear model for each outcome of interest.

Results: The presentation of the results is well-structured and in a logical sequence. However, the reporting of the statistical results is confusing and does not correspond to the usual standards (e.g. APA style). When reporting a p-values, it is necessary to know/understand which statistical test it refers to.
Reply: We have rephrased the 'Data Analysis' section of our methods to elucidate what statistical test the p-value represents. In short, the p-value was used for both the trends analysis (with a p-value <0.05 indicating rejection of the null hypothesis that no trend exists) and for the multivariate generalized linear model (with a p-value <0.05 indicating rejection of null hypothesis that the predictor variable is not associated with the response variable.
Changes in text: See 'Data Analysis' section of Materials and Methods. Page 8, lines 163-167: "Trends were assessed using the Cochran-Armitage Test for categorical data. The Mann-Kendall Test (non-parametric) and linear regression (parametric) continuous data. Generalized linear models were used to control for potential co-variates and to determine the potential independent risk factors for the outcomes of interest. Covariates with a P-value<0.2 were entered in our multivariate models. Statistical significance was defined as a P-value <0.05."

- Please provide data with mean±SD. Mean(SD) is confusing.
Reply: Done. Thank you.
Changes in text: See 'Results' section of Abstract and 'results' section of Manuscript.

- Please describe the covariates used for the generalized linear model. Here the APA-

style of reporting results is strongly recommended.
Reply: As mentioned above, we have addended our methods and results sections. Table 5 includes the co-variates that were included in the generalized linear model for each outcome of interest.
Changes in text: See 'Data Analysis' of Materials and Methods section. Page 8, Lines 163-168). "Trends were assessed using the Cochran-Armitage Test for categorical data. The Mann-Kendall Test (non-parametric) and linear regression (parametric) continuous data. Generalized linear models were used to control for potential co-variates and to determine the potential independent risk factors for the outcomes of interest. Covariates with a P-value<0.2 were entered in our multivariate models. Statistical significance was defined as a P-value <0.05." Table 5 includes the co-variates that were included in the generalized linear model for each outcome of interest.

- Please define LOS in the methods (line 198).
Reply: Done.
Changes in text: See 'Data Collection' of Materials and Methods. Page 6, lines 120-121: "Outcomes of interest included operative efficiency (robot time per screw), radiation exposure (fluoroscopy time per screw), robot complications (e.g. screw exchange, robot abandonment), clinical outcomes (e.g. length of stay [LOS=days between date of discharge and date of admission], 90-day reoperations), and other non-robot-related complications (e.g. dural tear, loss of motor/sensory function, blood transfusion)."

- Why was there a trend to open surgery over the years, robotic assistance actually promotes smaller approaches?
Reply: Thank you for bringing up this point. When we analyzed the specific subcategories for the indication for surgery, we expected to find an increase in deformity cases and perhaps an increase in the number of instrumented levels. Interestingly, we found that there was a statistically significant increase in the rate of high grade spondylolisthesis and spinal stenosis surgeries. This could potentially explain the increase in open versus percutaneous surgeries. It is also possible that the indication for surgery that is documented is not always complete since many patients, in reality, may have more than one reason for surgery (e.g. degenerative lumbar scoliosis with spinal stenosis and/or spondylolisthesis). Unfortunately, a multicentered study makes it difficult to examine this level of granularity. We acknowledge this limitation and have now addressed this in our limitations section of our discussion. Thank you.
Changes in text: See 'limitations' section of our Discussion. Page 15, lines 320-324: "Another limitation is the lack of granularity in the variable, the indication for surgery, which may not always be a single diagnosis and can be a combination of

pathologies (e.g. degenerative scoliosis and spinal stenosis). For instance, we observed that there was in increase in open versus percutaneous surgery and expected an increase in deformity cases; instead, there was an increasing trend for lumbar stenosis and spondylolisthesis cases."

- Renaissance seems to have higher rates of intraoperative screw exchange and robot abandonment. However, this is not discussed in the Discussion.
Reply: Thank you. We have addended our Discussion to include this.
Changes in text: See page 12-13, lines 258-262: "The specific advancements in technology that likely contribute to the improved screw accuracy and robot abandonment are the newer systems' ability (Mazor X and Mazor X Stealth) to preoperatively plan out the optimal screw placement based on 3D imaging and therefore better prepare for skive potential based on a patient's anatomy as well as the serial design of the robot arm, which improves the reach and range of motion for potential implant placement."

- In total, there is a bad reference between the results section and the tables/figures. Additionally, there is a lot of important data in the tables which are not mentioned in the results section. The results section should be rephrased completely.
Reply: Thank you. We have rephrased our results.
Changes in text: See 'Results' section of our manuscript.

Discussion/ Conclusion: The discussion and conclusions are well-written and comprehensible. However, it seems incomplete.
- There is no need to repeat statistics in the discussion section (line 243, 312)
Reply: This has been removed. Thank you.
Changes in text: See 'Discussion' section of our manuscript.

- 90 day reoperation rates were not described in the results but mentioned in the discussion section.
Reply: Done. Thank you.
Changes in text: See the final paragraph of the 'Results' section of our manuscript. "The overall 90-day reoperation rate was 2.8%, and did not change significantly over the last five years (P=0.828) (Table 4)."

- I suggest to include a paragraph concerning the basis of the improvements observed in the study. Is there a surgeons'/center's learning curve? Was there a center effect? I suggest, different centers had different robots. Did the improvement relate to different robots?
Reply: Thank you for your comment. We have addressed these points from the prior comments and reviewers. As mentioned above, two institutions (of the four) included

all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system. The learning curve was not directly examined in this study, which may be a major limitation since both 3rd and 4th generation robots were introduced and employed by each site during the study's time period. This point has been included in the limitaitons section of our discussion. Based on our multivariate analysis, the specific advancements in technology that likely contributed to the improved screw accuracy and robot abandonment are the newer systems' ability (Mazor X and Mazor X Stealth) to preoperatively plan out the optimal screw placement based on 3D imaging and therefore better prepare for skive potential based on a patient's anatomy as well as the serial design of the robot arm, which improves the reach and range of motion for potential implant placement. Our generalized linear model demonstrates that the X and Stealth robots (versus the Renaissance) were significant predictors for decreased fluoroscopic time per screw over the last five years. The reduced radiation exposure may be related to the improved robot registration as well as increased surgeon experience with robotic systems.

Changes in text: See the 'Patient Selection' section of the Materials and methods: "In this multicenter study, we included adult (≥18 years old) patients who underwent robot-assisted spine surgery between 2015 and 2019 at four geographically diverse institutions (Columbia University, Virginia Spine Institute, University at Buffalo Neurosurgery, and University of Virginia Health System). The robotic systems used included the Mazor Renaissance, Mazor X, and Mazor Stealth Edition. A minimum of 25 robot cases were performed per surgeon at each institution. Two institutions (of the four) included all three generation robots (Renaissance, Mazor X, Mazor X Stealth) during the study's period. Two institutions did not include the Renaissance system." See the Discussion, page 12-13, Lines 258-262: "The specific advancements in technology that likely contribute to the improved screw accuracy and robot abandonment are the newer systems' ability (Mazor X and Mazor X Stealth) to preoperatively plan out the optimal screw placement based on 3D imaging and therefore better prepare for skive potential based on a patient's anatomy as well as the serial design of the robot arm, which improves the reach and range of motion for potential implant placement."

- Renaissance seems to have higher rates of intraoperative screw exchange and robot abandonment. However, this is not discussed in the Discussion.

Reply: Thank you. As mentioned above, we have addended our Discussion to include this.

Changes in text: See page 12-13, lines 258-262: "The specific advancements in technology that likely contribute to the improved screw accuracy and robot abandonment are the newer systems' ability (Mazor X and Mazor X Stealth) to preoperatively plan out the optimal screw placement based on 3D imaging and

therefore better prepare for skive potential based on a patient's anatomy as well as the serial design of the robot arm, which improves the reach and range of motion for potential implant placement."

Language: In general, the language is of good quality. The legibility is good.
Reply: Thank you.
Changes in text: N/A

Figures/Tables: Tables are informative. However, their information is not reflected in the results section. State the statistical test used in the evaluation of the table s(e.g. in the table legend/footnote).
Reply: Done.
Changes in text: See footnote of each Table 1-5.

References: No objections.
My recommendation: In the present version, the manuscript is not of sufficient quality for publication. Major revisions are necessary.
Reply: Thank you for taking the time for providing insightful feedback. This was immensely helpful. We hope that we have addressed each of your points adequeately.
Changes in text: N./A

Reviewer D

The study does not provide any new information beyond what is already existent in the literature. While it does demonstrate the efficacy and improved workflow with the use of robotic technology, the overall translation in improved clinical outcomes or benefits remains controversial. The benefits of robotic for the placement of instrumentation are very well proven and the study just endorses the same. Studies directed towards furthering the role of robots beyond the placement of instrumentation and comparative efficacy against currently existing technology may be more valuable than reporting the efficacy of robots in placing screws that is not conjectural at this point.
Reply: Thank you for your comment. However, we believe that there is value in demonstrating in a multi-centered fashion that we are improving in some of the outcomes that we care about including screw accuracy, robot abandonment, robot time per screw. Our multicentered study of a larger sample size avoids some of the limitations and biases that are inherent in single center/single surgeon designs. Unfortunately, much of the prior literature are single center and limited to older generation systems (e.g. Renaissance). This study provides the most up to date

baseline data with a larger sample size on how our robot-assisted spine surgeries are currently performing. Future work will most certainly need to compare our findings to newer generation systems moving forward.

Changes in text: N/A