



Does Prehabilitation Improve Outcomes in Complex Spine Surgery Patients?

Development of Exercise-Focused Pilot Prehabilitation Program

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Abstract

Background: Evidence has shown that patients with multiple comorbidities, who are frail, and/or obese have higher rates of complications and poorer post-operative outcomes after spine surgical treatment. Many comorbidities that contribute to frailty and obesity are modifiable with physical activity which contributes to improved overall health. Multiple studies have shown that patients can benefit from a prehabilitation intervention prior to various surgeries; however, the impact and necessary components of a prehabilitation protocol for patients with adult spinal deformity has not yet been established.

Purpose: The purpose of this project is to use current evidence to develop a pilot prehabilitation protocol for spine surgery patients.
Methods: We retrospectively reviewed a control group of patients with symptomatic degenerative disc disease requiring spinal surgery receiving standard of care with focus on comorbidities, peri- and postoperative outcomes, adverse events, and patient-centered outcomes. Using this data, we will compare the patient-reported and objective outcome measures in those participating in a pilot prehabilitation program developed with current evidence and delivered through a software platform for data tracking.

Results: An overwhelming majority of patients in the control group were either overweight or obese, 42.9% and 34.3% respectively while 57.1% of patients had hypertension, 42.9% had sleep apnea, 25.7% had diabetes mellitus. Average length of stay was 6.6 ± 3.9 days. When tracked for the first post-operative year, patients were on opioids for 4.6 ± 4.7 months post-operatively with 25.7% still on opioids at 1 year. The most common complication was durotomy (34.3%) and notably 20% of patients had re-operation within the first year.

Conclusion: This pilot program will help to establish a multi-disciplinary approach to optimization of health prior to spine surgery and provide guidance on the most important factors to emphasize in a prehabilitation program.

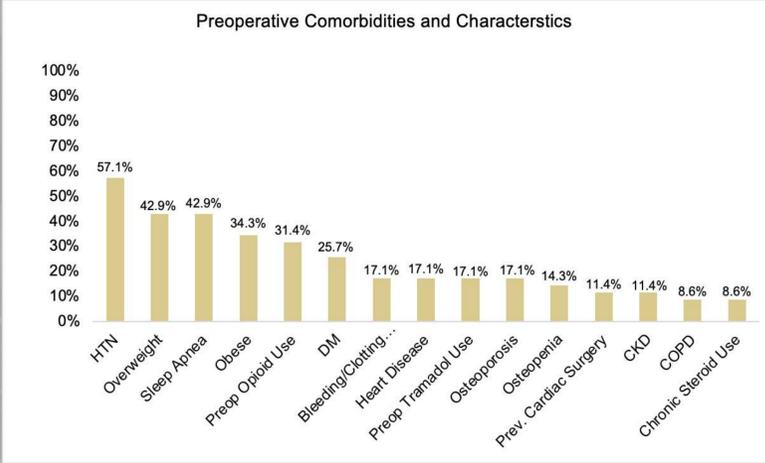
Introduction & Background

- Patients with low back pain have reduced levels of physical activity which contributes to obesity and other health problems that are associated with higher rates of complications and poorer post-operative outcomes after spinal surgical treatment.¹⁻⁷
- Many comorbidities evaluated in patients prior to deformity correction surgery can be modified with exercise, and evidence also suggests that frailty, which incorporates a large portion of these modifiable risk factors, is a major independent predictor of poor surgical outcomes.⁸⁻¹⁰
- To our knowledge, there is a paucity of published data with high a level of evidence concerning patients who underwent spine surgery after a prehabilitation program, especially in defining the extent of intervention that is required.
- This project has two phases with the first part retrospectively reviewing adult spinal deformity patients who underwent surgery. By reviewing the historical data, we will be able to assess the effects of current standard of care practices to make decisions on how to improve and modify future strategies to benefit this population of patients.

Methods - Retrospective

- This is a two-part study that includes a retrospective cohort analysis of a control group (inclusion & exclusion criteria defined in **Table 1**) utilized to develop an exercise-based prehabilitation program for a pilot study.
- The control group consisted of 35 patients and preoperative clinical characteristics (including but not limited to those shown in **Figure 1**) were noted.
- Complications and outcomes measures to be studied include minor and major complications (**Figures 3 & 4**), details of surgical intervention (**Table 4**), peri- and postoperative outcomes (**Table 3 & Figure 2**). Patient-centered outcomes at defined follow-up intervals during the first post-operative year were documented as well (**Figures 5-8**).

Figure 1. Distribution of preoperative comorbidities and characteristics



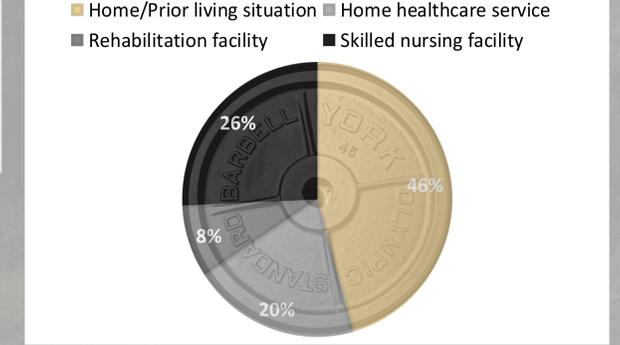
Abbreviations: DM: Diabetes Mellitus, CKD: Chronic Kidney Disease, COPD: Chronic Obstructive Pulmonary Disease



Table 3 Characteristics of perioperative outcomes.

Characteristic/Outcome	N(%) or Mean ± SD (Min;Max)
Length of Stay (days)	6.6 ± 3.9 (2.1;19.9)
Discharged on opioids	31(88.6)
Postoperative time on opioids (months up to 1 year)	4.6 ± 4.7 (0;12)
Still on opioids at 1 year	9(25.7%)

Figure 2. Discharge Destination



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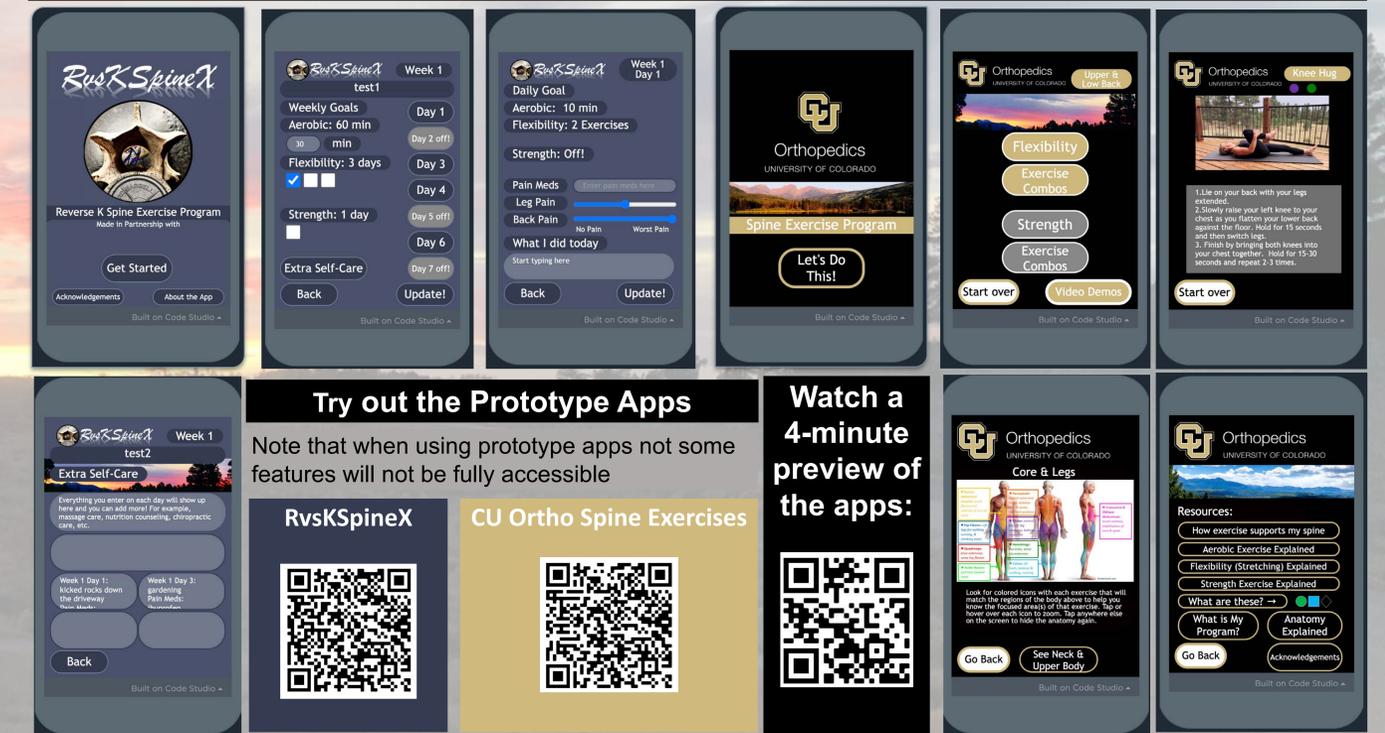
Learning Objectives

- Review historical data to develop an understanding of characteristics of patients with adult spinal deformity.
- Develop 8-week prehabilitation protocol using historical data and current evidence for exercise program design.
- Create an integrative platform of delivery of program to patients.

Methods – Prospective Pilot

- The prehabilitation program, **RvskSpineX**, is an 8-week progressive exercise program designed to help patients start from no or minimal exercise. It was developed using an evidence-based progressive training format^{11,12} and incorporates aspects of aerobic, resistance, and flexibility training.
- The program will be delivered to patients in a week by week, day to day format and allow for tracking and monitoring of participation through PatientIQ software, a data collection platform already incorporated into the University of Colorado Orthopedic Surgery patient pathways.
- The program will be paired with the originally developed **CU Ortho Spine Exercises**, another prototype smartphone application that consists of all recommended resistance and flexibility exercises.
- We estimated effect size of 30% for establishing sample size for pilot study that accounted for patient-reported clinical outcomes (**Figures 5-8**). Powering the study at 80% with p < 0.05, we plan to enroll 60 patients in the prehabilitation intervention group. Patients will be recruited using the same inclusion and exclusion criteria.
- Continuous variables will be compared between study groups using 2-tailed 2 sample T-test while categorical outcomes will be compared by 2-tailed Fisher's exact test and odds ratio.

Figure 9. Screenshots of prototype smartphone applications



Try out the Prototype Apps

Note that when using prototype apps not some features will not be fully accessible

RvskSpineX



CU Ortho Spine Exercises



Watch a 4-minute preview of the apps:



Results & Conclusions

- Using the control group data, we can place some emphasis on targeted comorbidities in developing a prehabilitative program, most of which can improved with exercise.
- Understanding the high rate of DM, HTN, and sleep apnea in the setting of 80% of our sample being overweight or obese at the time of surgery helps to tailor how the program should be designed.
- The 8-week prehabilitation program takes into consideration these most common modifiable comorbidities as well as their orthopedic spine condition to develop emphasis in areas of resistance, flexibility, and aerobic training.

Limitations & Future Directions

- This study is limited by:**
- Small sample size, retrospective design of obtaining control group data, and heterogeneity of variables.
 - Comparison to prospective intervention group in pilot study may have different patient outcome measures due to development of new questionnaires.
- Future Directions:**
- Assess how any prehabilitative activity impacted pain and disability status in patients with degenerative disc disease (DDD) undergoing spinal surgical treatment, peri- and postoperative treatment outcomes including complications, and the overall treatment cost.
 - Use results to continue adaptation of effective prehabilitation program.

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