

Same-Day Anterior Cervical Discectomy and Fusion—Our Protocol and Experience: Same-Day Discharge After Anterior Cervical Discectomy and Fusion in Suitable Patients has Similarly Low Readmission Rates as Admitted Patients

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ABSTRACT

Background: Outpatient anterior cervical discectomy and fusion (ACDF) is performed frequently, with studies demonstrating similar complication and readmission rates compared to traditional admission. Advantages include cost effectiveness, as well as lower risk of nosocomial infections and medical errors, which lead to quicker recovery and higher patient satisfaction. Protocols are needed to ensure that outpatient ACDF occurs safely. The objective of this study was to develop and implement a protocol with patient selection and discharge criteria for patients undergoing same-day discharge (SDD) ACDF and assess readmission rates.

Methods: A retrospective chart review was performed to identify patients undergoing 1 or 2 level primary ACDF between March 2016 and March 2017 who were eligible for SDD according to the institutional protocol (Figure 1, Table 2). Patients with identical surgery and discharge dates were grouped as SDD, and admitted patients were grouped as same-day admission (SDA). Using our electronic health record's analytics, readmissions in the 90-day postoperative period were identified.

Results: Of the 434 patients identified, 126 patients were SDD, and 308 were SDA. Baseline characteristics such as age, operative time, and time in the recovery room were significantly different between the 2 groups (Table 2). The average length of stay of admitted patients was 1.48 days, with 77% discharged on postoperative day 1. There was an overall, noninferior readmission rate of 0.8% in the SDD group compared to 0.6% in the SDA group ($P = .86$).

Conclusions: The results of this study support the feasibility of outpatient ACDF and add a patient selection and discharge criteria to the literature. Proper identification of suitable patients using our protocol results in a noninferior readmission rate, allowing surgeons to continue to safely perform these surgeries with a low readmission rate.

Level of Evidence: 3.

Clinical Relevance: SDD is safe in the appropriate patient population.

Cervical Spine

Keywords: anterior cervical discectomy and fusion, ambulatory, outpatient, same day discharge, protocol

INTRODUCTION

Anterior cervical discectomy and fusion (ACDF) is one of the most commonly performed spinal surgery procedures, and the reported number of cases per year is steadily increasing.^{1–6} More ACDF surgeries are being performed in the outpatient setting, as is the trend in several other orthopedic subspecialties. This transition is largely due to relatively short operative times and associated reduction in general anesthesia, increased utilization

of minimally invasive approaches and allograft, which has eliminated graft site morbidity, as well as improvement in spinal instrumentation tools and techniques.^{7–12}

Various studies have demonstrated that outpatient ACDF is both safe and effective and has comparable complication, reoperation, readmission, and mortality rates to inpatient ACDF.^{13–19} Some studies have even demonstrated superior outcomes with respect to morbidity and reoperation rates.^{1,20} Outpatient surgery is more cost effective, with

Same Day ACDF Clinical Pathway

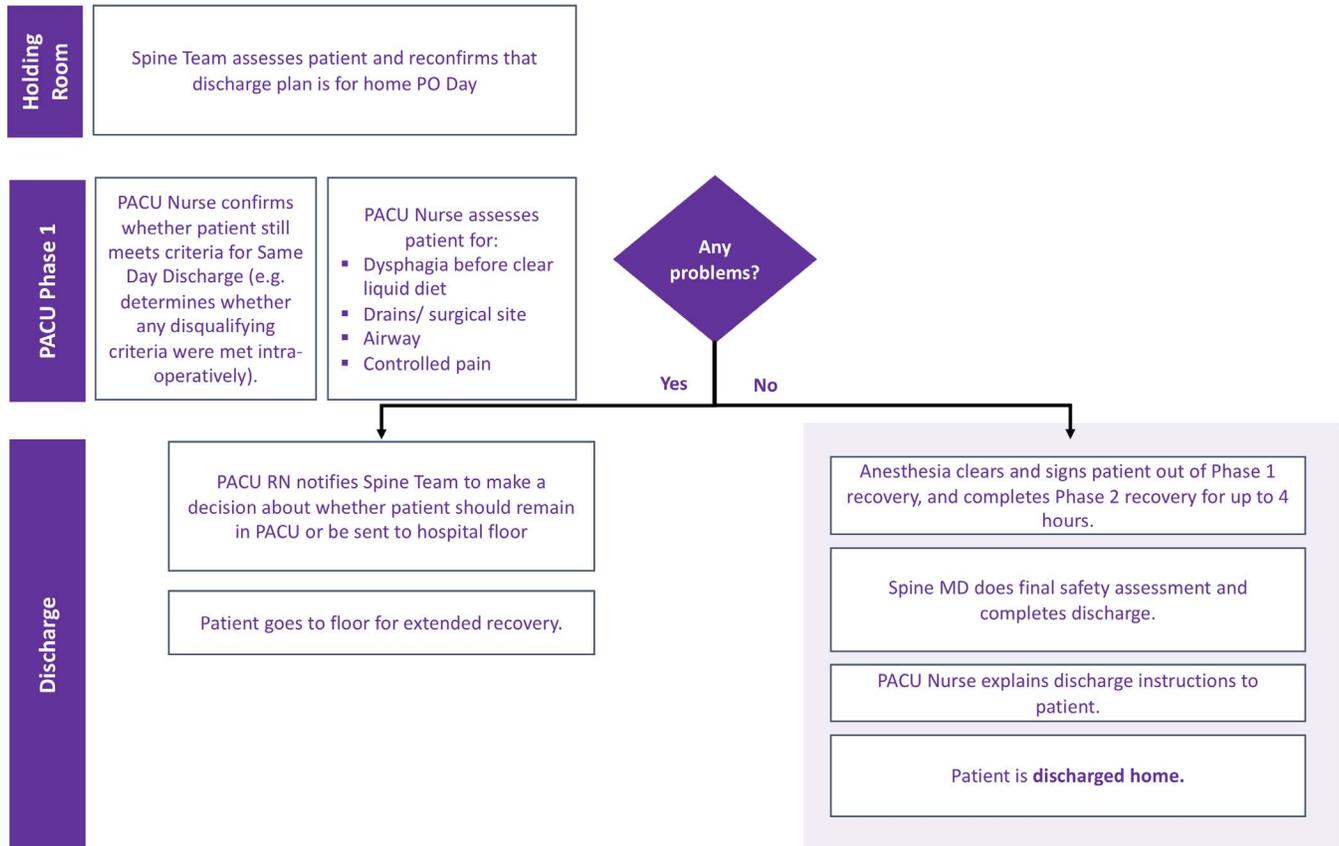


Figure 1. Same-day anterior cervical discectomy and fusion workflow protocol.

annual cost savings of up to \$140 million on a national level.^{1,11,21,22} Additionally, less time spent in the hospital reduces the risk of nosocomial infections and medical errors, leading to quicker recovery and higher patient satisfaction.^{1,11,17,22–26}

Due to the demonstrated benefits, including cost effectiveness and patient satisfaction, without an apparent compromise in safety or efficacy, it is likely that the majority of ACDFs will be converted to outpatient status by insurance companies. Given this eventuality, a protocol to ensure that same-day ACDF is carried out safely is paramount. Some studies have suggested that ideal candidates for outpatient ACDF are less than 65 years old, functionally independent, lack significant medical comorbidities or bleeding disorders, and have American Society of Anesthesiologists (ASA) scores less than 3.^{19,27} These patients are typically indicated for a primary 1- or 2-level ACDF, with anticipated operative time less than 4 hours, and have no evidence of complications at the end of the observation period.^{19,27} Though these studies have implied certain guidelines for patient selection and

discharge criteria, a specific protocol for same-day discharge (SDD) ACDF has yet to be defined in the current literature.^{19,28}

At our institution, a multidisciplinary task force developed a protocol for SDD ACDF. The protocol uses strict inclusion criteria, multiple assessments, and adequate observation to ensure safe discharge of ACDF patients on postoperative day 0. We hypothesize that using our protocol to identify patients for outpatient ACDF will result in a noninferior readmission rate compared to traditional same-day admission (SDA) ACDF.

METHODS

A retrospective chart review of all patients who underwent 1- or 2-level ACDF between March 2016 and March 2017 in a single academic orthopedic hospital was performed. Patients who underwent cervical disc replacement, hybrid procedures, 3- or more level surgery, corpectomy, posterior or revision procedures were excluded. Data extracted included age, gender, body mass index (BMI), date

Table 1. Patient and surgery characteristics.

Parameter	SDA	SDD	P Value
Age	51 ± 11	46 ± 11	<.001
Gender (M : F)	0.82	1.47	.006
Smoking status, %	14%	25%	.004
Length of stay, d	1.4 ± 1.2	0 ± 0	<.001
No. of levels operated	1.6 ± 0.5	1.3 ± 0.5	<.001
Surgical time, min	179 ± 53	127 ± 39	<.001
Recovery room time, min	183 ± 82	306 ± 106	<.001

Abbreviations: F, female; M, male; SDA, same-day admission; SDD, same-day discharge.

of surgery, discharge date, surgical procedure, surgical time, and recovery room times (Table 1). All patients underwent ACDF via the Smith-Robinson approach³ with implants based on surgeon preference.

Patients were then grouped as SDD and SDA. Patients were classified as SDD only if their surgical date and discharge date were the same calendar day. Discharges within 23 hours were not considered as SDD if their surgical date and discharge date did not match.

Using our electronic health record's analytics tools, readmissions were flagged to identify any ACDF patients who were readmitted to the hospital for any reason in the immediate 90-day postoperative period. Patients who were identified to be admitted in the 90-day postoperative period for an unrelated surgical procedure not involving the cervical spine and with medical issues unrelated to the index ACDF procedure were not included as readmissions. Institutional review board approval was obtained prior to the initiation of this study.

Statistical Analysis

All protected health information was removed by de-identifying the dataset. Statistical analyses were employed using Stata Statistical Software: Release 11 (StataCorp LP, College Station, TX). Student *t* tests were used for comparative analysis between the SDD and SDA groups. Statistical significance was defined as $P < .05$.

Patient Selection and Protocol

Those who met the inclusion criteria for same-day ACDF were scheduled for outpatient procedures. In order to qualify, patients must be younger than 65 with a BMI less than 35, ASA score less than 3, and no history of cerebrovascular accident, transient ischemic attack, coagulopathy, or bleeding diathesis. The patient must also be indicated for

Table 2. Same-day anterior cervical discectomy and fusion (ACDF) criteria.

Candidates for Same-Day ACDF Surgery Include Patients With ALL of the Following Characteristics:

- Age <65 y
- Body mass index <35 kg/m²
- ASA score <3
- No history of coagulopathy/bleeding diathesis
- No history of CVA or TIA
- Surgery on 1 or 2 spinal levels
- Primary (not revision) surgery
- Operating room time less than 180 min
- No operative complications
- No immediate postoperative wound complications
- No significant postoperative dysphagia
- Hemodynamically stable in the recovery room without uncontrolled hypertension
- Not requiring high dose analgesics
- No respiratory alarm signs in the recovery room, which may include any of the following:
 - Difficult airway per anesthesia
 - Inability to wean supplemental oxygen
 - Witnessed obstructive apnea/hypopnea
 - Escalating pain medication requirements
 - Pain versus sedation mismatch

Abbreviations: ASA, American Society of Anesthesiologists; CVA, cerebrovascular accident; TIA, transient ischemic attack.

primary 1- or 2-level ACDF. The operative time must be less than 180 minutes without complications. Selected patients were monitored postoperatively in the recovery room for a minimum of 4 hours and must be without any complications or concerns from the anesthesia, nursing, and surgical teams prior to discharge. A full list of criteria can be seen in Table 2.

While in the first stage of recovery, nurses are specifically evaluating for any issues that would preclude SDD. These include significant bleeding at the surgical site, dysphagia, inability to wean supplemental oxygen, any witnessed obstructive apnea, escalating pain medication requirements, or pain versus sedation mismatch. If there are any issues, the recovery room nurse practitioner will evaluate the patient to determine if he or she needs to be temporarily monitored on the inpatient floor where a nurse practitioner from the spine service can reevaluate the patient for discharge. If there are no issues, the patient will move to the second stage of recovery, where he or she are monitored further and then reevaluated by a member of the orthopedic team prior to discharge to home. An overview of the workflow is seen in Figure 1.

RESULTS

A total of 434 patients underwent 1- or 2-level ACDF at our institution from March 2016 to March 2017. One hundred twenty-six patients were

discharged on the day of surgery and considered to be SDD, and 308 patients were admitted to the hospital immediately following surgery and categorized as SDA. Basic demographics across the 2 groups were similar, although there were some statistically significant differences between the groups, as seen in Table 1, which are likely attributable to the selection criteria used for identifying patients suitable for outpatient ACDF.

Of the admitted patients, 77% of them left on postoperative day 1, and the average length of stay was 1.48 days. There was no statistical difference in readmission rates between the 2 groups. In each of the SDD and SDA groups, there was 1 patient who was readmitted in the 30-day postoperative period. The SDA group had 1 patient who was admitted in the 30- to 90-day postoperative period. In the SDD group, 1 patient was readmitted for dysphagia and was treated with a steroid taper and a soft diet and was discharged home after 2 days. In the SDA group, 1 patient was readmitted in the 30-day postoperative period for orthostatic hypotension and syncope. The patient was treated with fluid resuscitation, but the orthostatic hypotension persisted. Further cardiac workup including echocardiography was normal, and the etiology was deemed to be vasovagal syncope in the context of valsalva. The additional patient admitted in the SDA group during the 30-90-day postoperative period was for recurrence of symptoms and underwent a revision cervical surgery. This resulted in a 30-day readmission rate of 0.8 and 0.3% in the SDD and SDA groups, respectively. There was no significant difference in overall readmission rates for the SDD and SDA groups (0.8 versus 0.6%, $P = .86$). Furthermore, an analysis of our patients to identify all readmissions for any reason following the index procedure, no additional readmissions were identified.

DISCUSSION

Improvements in surgical technique and technology have allowed for shorter length of stay and even SDD following spine surgery. With a growing trend toward outpatient surgery, given its cost savings and efficiency compared to admission, accurate identification of patients who would be appropriate for outpatient ACDF is critical to preventing complication and readmission that would otherwise decrease the advantage of outpatient surgery. The purpose of this study is to add to previous literature which has identified outpatient ACDF as a safe and viable option by demonstrating the results of a definitive protocol for

patient selection in a high-volume academic center while showing noninferiority with regard to readmission rates when compared to patients who are admitted following surgery.

Our results show that the protocol created for selection of patients suitable for outpatient ACDF led to a similar readmission rate as patients undergoing SDA ACDF. Readmissions as defined by the Centers for Medicare and Medicaid Services is a measure of unplanned all-cause readmission after admission for any condition within 30 days of hospital discharge.²⁹ Additionally, we define outpatient surgery as patients whose surgery date and discharge date are the same. Previous studies have categorized patients who are placed under 23-hour observation as outpatient. In the SDD group, 1 out of 126 patients (0.8%) was readmitted in the 30 days following surgery compared to 1 out of 308 patients (0.3%) in the SDA group. In our study, we expanded our analysis to look for any readmissions in the 90-day period following hospital discharge and found 1 additional patient from the SDA group who was readmitted. There were no statistical differences between groups for both the 30- and 90-day readmission rates, which supports our hypothesis and shows noninferiority with regard to readmission.

The feasibility of outpatient ACDF was first described by Stieber et al. in 2005 in which they used 1- or 2-level involvement, absence of myelopathy, subjective neck size, and estimated operative time to identify patients for outpatient ACDF.¹⁷ Their criteria resulted in a lower rate of complications likely due to selection bias. Since then, many studies have reported on the comparable complication rate between outpatient and SDA ACDFs, but do not specifically comment on patient selection.^{1,14,18,20} Trahan et al. recently expanded on the selection criteria by including low medical comorbidity and adequate postoperative family care in the preoperative selection process.¹⁹ They also reported on postoperative criteria including 6 hours of postoperative monitoring, no evidence of postoperative complication, and patient willingness to be discharged. Although these studies have selection and discharge recommendations, more specific criteria are needed to maximize safety and cost savings.

With respect to readmissions, Adamson et al. compared 1000 outpatient ACDFs to 484 SDA ACDFs and found a similar 30- and 90-day readmission rate (1.8 versus 2.9%, $P = .24$, and

1.3 versus 1.5%, $P = .8$, respectively).¹³ In this study, the sample size was large; however, the readmission rate was higher when compared to our study. This may be due to the lack of a defined protocol for proper patient selection. Similarly, McClelland et al. performed a database analysis of 1528 patients who underwent outpatient ACDF and found a 7-day readmission rate of approximately 6% and, although underpowered, found no difference in perioperative complications between the readmitted and nonreadmitted groups.¹⁵ However, this study is limited, as it is a database study based on International Classification of Diseases, Ninth Revision, codes rather than chart review and was looking specifically at 7-day readmission rate, which does not adhere the Center for Medicare Services definition of readmission. As a result, several relevant readmissions may be missed. A review of the literature revealed that patients undergoing ACDF are most commonly readmitted for observation due to hematoma causing dysphagia or dysphagia, which is likely attributed to retraction and resultant swelling.^{14,17,19} In our study, we had a very low readmission rate in both the SDD and SDA groups. A total of 3 patients were readmitted, 1 in the SDD group for dysphagia and 2 in the SDA group for orthostatic hypotension and recurrence of symptoms. Given the relatively low rate of readmissions, we believe that the patient selection protocol presented in this study can safely identify patients for outpatient ACDF.

It has been well established in the current literature that outpatient ACDF is a feasible option for the correctly selected patient, but the question of who that patient is remains to be answered. Various studies examining outpatient ACDF have touched on guidelines for ideal patient selection. In most studies, for example, patients undergoing revision ACDF or that have pathology spanning 3 or more levels are not candidates for SDD.^{1,11,13,15,16–20,22} Mohandas et al. reported best-practice guidelines for outpatient ACDF agreed upon by a multidisciplinary panel.²⁸ Guidelines that demonstrated 100% consensus included a thorough assessment of thromboembolic risk as well as excluding patients with ASA score ≥ 3 , which has also been described in other studies.^{1,13,27}

Most studies did not exclude based on age or weight; however, Stieber et al. compared ACDF outcomes at an ambulatory surgery center to ACDF in a hospital setting and had mean BMI < 35 in

both groups, with no complications requiring admission in the outpatient surgery group.¹⁷ Using the National Surgical Quality Improvement Program database, McGirt et al. compared patient characteristics and outcomes in inpatient and outpatient ACDF and found that inpatients were older with mean ages 49 and 53 years old for outpatient and inpatient, respectively.¹

Operative time < 180 minutes for same-day ACDF has been well supported in current literature.^{18,27} Erickson et al. evaluated patient satisfaction after outpatient ACDF using questionnaires, finding that 95.6% of patients were satisfied, no readmissions at 3 months, and mean operative time was 89.4 minutes.²² Trahan et al. retrospectively examined readmissions and complications after outpatient ACDF and reported a 1.4% complication rate with mean operative time of 85.5 minutes.¹⁹ In a meta-analysis by McClelland et al. assessing complication and readmission rates in outpatient ACDF, a mean operative time of 90 minutes is reported.¹⁶

An exact amount of time spent monitoring same-day ACDF patients has not been determined; however, mean observation time from 4–8 hours has been reported.^{13,16,18,19} For example, Tally et al. report average hospital stays of 4.7 and 5.4 hours in single- and 2-level ACDF, respectively, in their retrospective chart review evaluating complication rate of same-day ACDF at an ambulatory surgery center.¹⁸ Trahan et al. also describe discharge criteria including a minimum of 6 hours of postoperative monitoring, well-controlled pain, as well as the absence of complications including a palpable hematoma or dysphagia.¹⁹ As our data demonstrate, SDD patients spent an average of 5 hours in the recovery room being monitored. After the initiation of this protocol, we have not identified any patients who have developed significant problems after 4 hours of observation, and we are therefore considering shortening the postoperative observation period. It is certainly possible that our patient selection criteria could be broadened, and conditional criteria can be further modified and yet still result in a noninferiority with regards to readmission. However, to our knowledge, this is the first study to outline a protocol for same-day ACDF patient selection and discharge and to directly compare readmissions rates between outpatient and SDA ACDF patients after instituting a specific protocol.

This study is not without limitations. First, the sample size is relatively small, given that the inclusion period was limited to 1 year at 1 institution. Furthermore, our protocol has not been validated and was formulated via a combination of anecdotal and evidenced-based medicine by a multidisciplinary group of orthopedic surgeons, critical care physicians, and nurses. Future studies should be aimed at expanding the patient selection and discharge criteria and its effects on complications and readmissions on a larger scale.

CONCLUSIONS

The results of this study support the feasibility of outpatient ACDF and add a patient selection and discharge criteria to the literature. Using the aforementioned protocol, there is no significant difference in readmission rates between outpatient and SDA ACDFs. The proper selection of patients for outpatient ACDF will allow surgeons to continue to safely perform these surgeries with a low readmission rate.

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