Anterior Cervical Discectomy and Fusion Comorbidity Complication Rates: A Meta-Analysis

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INTRODUCTION: There are many different studies analyzing the complication rate after ACDF using databases, case studies, case series, or single-surgeon/institution comparisons. However, each of these reports complication rates differently or analyzes different niches of ACDF complication rates, such as inpatient vs outpatient or analyzing a specific factor such as BMI. McClelland et al (2016) performed a meta-analysis examining the rates and types of complications across 13 studies. However, this study did not examine the factors that lead to those complication rates. Previous studies on other spine surgeries have supported the notion that there is an increased risk for complications and mortality in older populations. However, complication risk is multifaceted and keeping age solely as a measure of risk is not sufficient. No study summarizes each of these factors altogether, which is especially important when unclear conclusions exist surrounding some factors. The aim of this study is to summarize and clarify how each factor affects the risk of operation.

METHODS: A systematic literature search was conducted using PubMed, Embase, and Scopus to identify studies examining comorbidities and complications associated with anterior cervical discectomy and fusion (ACDF). The initial search was executed on May 30th, 2025, returned 155 results. Titles and abstracts were independently screened by two authors (VS and AK) followed by a full text review of the 108 articles that were related to ASDF; 7 studies were then selected. The way each manuscript described their complication rate slightly differently between studies, but they all generally encompassed a readmission, mortality, unexpected extended length of stay, or specific respiratory, neurologic, cardiac, or septic complication. Odds ratio was recorded or independently calculated using the study's published sample sizes. The list of studies used for this review can be found in Table 1. P-values less than 0.05 were included in this study.

RESULTS SECTION: Each study utilizes different age brackets for analysis. Together, the meta-analysis indicates that generally at ages over 50, there is an increased risk of complication during ACDF surgery by a factor of 2.898 (Figure 1). Neurological and Behavioral diagnoses have strong increased risk profiles for performing ACDF surgery (Figure 2). Schizophrenia has a 90-day increased readmission risk by a factor of 4.636 (Figure 2). Psychosis has an increased risk of complications by a factor of 3.946 (Figure 2). Neurologic Disease as a broad category itself has an increased risk by a factor of 3.504 (Figure 2). Alcohol use disorder increased risk of complications by a factor of 3.23 (Figure 2). Schizophrenia has a 30-day increased readmission risk by a factor of 2.839 (Figure 2). Drugs use disorder increase the risk of complications by a factor of 2.33 (Figure 2). Depression has an increased risk by a factor of 1.073 (Figure 2).

DISCUSSION: Examining the effect of age on risk of complication during ACDF is done with varying age brackets in different papers. Some papers analyze age as a binary factor, such as Narain et al., examining age above or below 50 years old. There is a loose trend that higher ages result in increased risk of complication, which may be expected. However, until age 70, there is conflicting evidence on the extent to which age plays a role in complication risk. For ages 50-59 and 60-69, one large sample-size study reports a low odds ratio (Renfree et al., 50-59, OR = 0.831; Renfree et al., 60-69, OR = 0. 948). However, other studies reported a much higher OR as high as 4.4 yet with a significantly smaller population size. Other conflicting evidence is seen with age ranges 50+ and 65+, as these ranges include ages 50-70 but have high OR values (Narain et al., Age > 50, OR = 3.5; Lovecchio et al., Age > 65, OR = 3.501). These studies were also performed with smaller population sizes which may have contributed to such results. However, this may also be because the complication risk in older populations are skewing this average upwards. As a result, while most of the patients in the 50-70 age range are not contributing to this value, due to the lack of stratification among this age bracket, the exact contribution as age increases cannot be determined. This is supported by studies that have ages ranges of 75+ and 80+ where complication rates are much higher (Renfree et al., age > 80, OR = 3.715; Brodell et al., age > 80, OR = 20.4; Buerba et al., age > 75, OR = 2.83). Together, this suggests that age is not a significant factor for increasing complication rate until after around age 70 when the risk drastically increases.

Neurologic, Psychiatric, and Behavioral diseases and diagnoses all contribute to an increased risk of complications during surgery. In contrast, depression only has a slight increase (Ranson et al., Depression, OR=1.073). However, unless an emergency surgery or severe neurologic damage is indicated, many of these patients with psychosis or schizophrenia may not be selected for surgery. Many studies have supported the notion that comorbid mental illnesses worsen surgical or medical outcomes including increased mortality rates and disparities in operative outcomes. One study also loosely suggests that outcomes are worsened by mental illness. However, there is little published literature on specifically mental illness and spinal surgery. As a result, it is important to help clarify the complex relationships between mental illness and surgical outcomes to prevent complications and assist with risk management.

SIGNIFICANCE/CLINICAL RELEVANCE: (1-2 sentences): Awareness of the correlation between an individual's demographics and comorbidities can helps influence perioperative/intraoperative management and risk assessment for certain patients. Understanding an individual's risk for ACDF is important to consider when determining whether the risk of operation outweighs the potential benefit especially in complex circumstances where patients have multiple comorbidities and surgery may not improve the patient's quality of life.

IMAGES AND TABLES:

Table 1. References used in meta-analysis.

Citation	Number of Patients
Narain AS et al. (2020)	310
Alvi M.A. et al. (2020)	139877
Brodell D.W. et al. (2014)	6351
Buerba R.A. et al, (2014)	6230
Lovecchio F. et al, (2014)	2320
Ranson W.A (2020)	261780
Renfree SP (2019)	39371

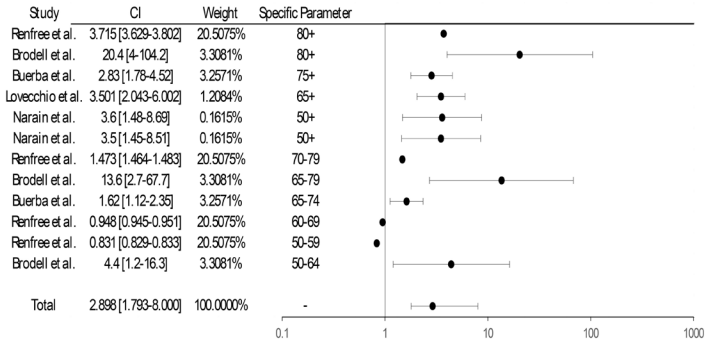

Figure 1. Odds Ratio for complications from ACDF at ages above 50. Odds Ratio, Confidence interval, and the study for each data point is shown. The bottom data point is the cummulative weighted average of all complication risks at all ages.

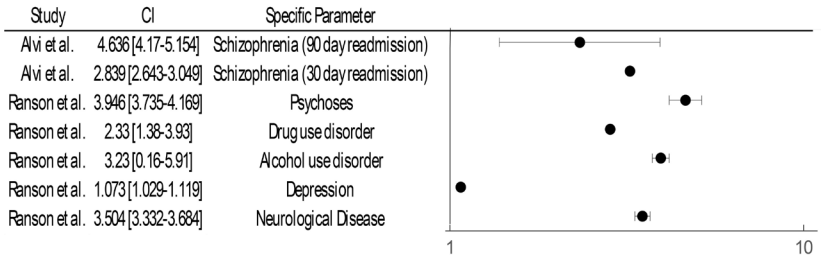

Figure 2. Odds Ratio for complications from ACDF for different neurological and behavioral comorbidities. Odds Ratio, Confidence interval, and the study for each data point is shown.