Failure Patterns in Standalone Anterior Cervical Discectomy and Fusion Implants

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BACKGROUND: **Anterior cervical discectomy and fusion is commonly performed using an allograft or autograft implant and anterior screw-supported plate. There has been an increase in the use of standalone cage devices due to ease of use and studies suggesting a lower rate of acute postoperative dysphagia. We review our experience with standalone cage devices and identify risk factors, patterns of failure, and revision surgery approaches.**

METHODS: **We performed a retrospective case series of patients treated at a single tertiary care institution between March 2014 and March 2015. Inclusion criteria were aged 18–100 years, 1- or 2-level anterior cervical discectomy and fusion with a standalone cervical cage. Data collected included demographics, comorbidities, Charlson comorbidity score, primary diagnosis, and surgical characteristics. Descriptive statistics were performed for risk of readmission, implant failure, revision, and other complications.**

RESULTS: **We identified 211 patients who met our study criteria. Average surgical time was 107 ± 43 minutes, with an estimated blood loss of 84.6 ± 32.4 mL. There were 11 (5.2%) readmissions. There were 10 (4.74%) implant failures (5 involving single-level surgery and 5 involving 2-level surgery), with 7 cases of pseudoarthrosis. Mechanisms of failure included a C5 body fracture, fusion in a kyphotic alignment after graft subsidence, and acute spondylolisthesis.**

CONCLUSIONS: **Revision surgery after standalone anterior cervical implants can be complex. Posterior cervical fusion remains a valuable approach to avoid possible vertebral body fracture and loss of fusion area associated with the removal of implants secured through the endplates of adjacent vertebral bodies.**

INTRODUCTION

Anterior cervical discectomy and fusion (ACDF) is used for the treatment of multiple spinal conditions, including degenerative disc disease, herniated discs, deformity, and trauma. ACDF is most commonly performed with the use of allograft/autograph and anterior screw-supported plate systems (ASPS). In a single-level case, the allograft is supported by a 4-screw construct, with 2 screws placed in the anterior vertebral body surface of each fused level.

Recently introduced zero-profile standalone implant (ZPSAI) devices have shown comparable efficacy in mostly single-level disease.[1-4] Standalone cages hold several benefits versus traditional plate systems, including ease of implantation due to the lack of anterior plating. As low-profile standalone cages do not require placement of a plate, potentially avoiding esophageal irritation or abutment. It has been suggested that the rate of acute postoperative dysphagia may be lower with these devices.[2]

With the increasing use of ZPSAI implants among surgeons, an examination of the associated complications is imperative. We believe the type of fixation used to stabilize these cages, in which screws are deployed through the endplates, poses a risk for a type of stress failure we have termed the windshield wiper effect. Nonunion in standalone cages may lead to movement of the screws and subsequent destruction of the vertebral bodies,

Key words
- Cervical discectomy
- Cervical plate
- Complications
- Interbody
- Myelopathy
- Radiculopathy

Abbreviations and Acronyms
ACDF: Anterior cervical discectomy and fusion
ASPS: Anterior screw-supported plate systems
ZPSAI: Zero-profile standalone implant

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Citation: World Neurosurg. (2017) 108:676-682.
https://doi.org/10.1016/j.wneu.2017.09.071

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

necessitating subsequent revision surgery. We reviewed 211 cases to identify the patterns of failure and type of revision surgery required after the use of standalone cages in cervical spine fusion. To our knowledge this is the largest study presenting mechanisms of failure in standalone cages.

METHODS

Study Design

This was a retrospective case series of patients treated at a single tertiary care institution between March 2014 and March 2015. The study was approved by the Swedish Medical Center Institutional Review Board.

Study Population

Consecutive patients during the study period were identified and those meeting study criteria were included. Inclusion criteria were aged 18–100 years and anterior cervical fusion with a standalone cervical cage system involving 1–2 cervical levels. Exclusion criteria included patients who had a corpectomy, posterior cervical procedure, or any other procedure in combination with a standalone cage implant. The patient population was collected from a prospectively maintained Swedish surgical database.

Data Collected

Baseline and Surgical Characteristics. The following baseline information was collected: general demographics (sex, age, body mass index) and medical history and comorbidities (Charlson comorbidity score, chronic obstructive pulmonary disease, diabetes, cardiovascular disease, immunosuppression status, history of smoking, prior cervical surgeries). The following surgical characteristics were collected: indication for the index surgery with standalone cage (myelopathy, radiculopathy, trauma, and/or deformity), pathology of the index surgery (disc herniation, spondylotic myelopathy, trauma, infection, or tumor), type of standalone cage used, levels of surgery, side of approach, graft material, length of surgery, and estimate blood loss.

Complications, Readmissions, and Patterns of Failure. We recorded readmission, revisions, and patterns of failure for a 2-year follow-up period. The time interval between the index standalone surgery and the onset of new symptoms requiring revision was recorded. Symptoms requiring revision were collected and classified as neck pain, radiculopathy, and/or myelopathy. Patterns of failure were classified as pseudoarthrosis, new fracture, and/or kyphosis.

Statistical Analysis

We present descriptive statistics for all baseline measures and outcomes. For categorical variables, frequency counts were computed and presented along with their percentages. For continuous measures, their means were presented along with their standard deviation.

RESULTS

Patient Demographics

Of the 384 patients identified as having undergone ACDF, 173 were excluded for procedures that did not meet study criteria. The remaining 211 patients had undergone standalone procedures (Figure 1).

Baseline and Surgical Characteristics

The baseline and surgical characteristics of the 211 patients who underwent the standalone implant are presented in Table 1. The average duration of surgery and estimated blood loss with the use of standalone devices was 107 ± 43 minutes and 84.6 ± 32.4 mL, respectively.

Complications and Readmissions

Of the 211 patients with ZPSAI, 10 (4.74%) experienced implant failures (Table 2). A total of 11 readmissions were identified (Table 2). Most (9 of 11) occurred within 30 days and were due to medical reasons. Two patients were readmitted with dysphagia, which was managed nonoperatively.

Patterns of Failure

This subgroup had an average age of 59.4 years (32–88 years) and included 9 women. The index indication for the surgical intervention was degenerative cervical spine disease presenting as neck pain with myelopathy or radiculopathy (Table 3). The level of surgery was single-level in 5 cases and 2-level in the remaining cases.

Pseudoarthrosis was the most common pattern of failure occurring in 7 cases (Table 4). Mechanisms of failure included a C5 body fracture, fusion in a kyphotic alignment due to graft subsidence, and acute spondylolisthesis.

The average time interval between the index surgery and the revision surgery was 382.9 days (range, 2–838 days). Two patients had a very short time interval before revision (Case 2 and 6). Case 2 developed an acute postoperative kyphosis at C3-C4 with sudden worsening of neurological symptoms and underwent a combined front/back (circumferential) approach due to concerns for progression of their deformity (Figure 2). Case 6 presented with an acute onset of severe neck pain and neurological symptoms secondary to a C5 vertebral body fracture at the site of the screw

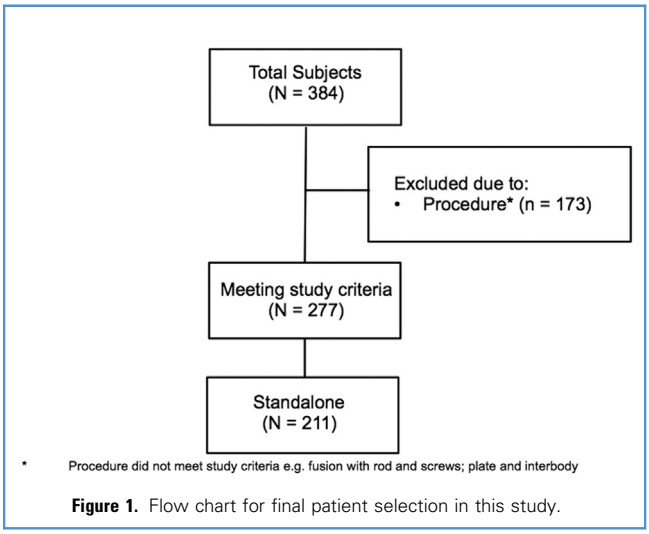

Figure 1. Flow chart for final patient selection in this study.