# Multilevel Anterior Cervical Diskectomy and Fusion with Zero-Profile Devices: Analysis of Safety and Feasibility, with Focus on Sagittal Alignment and Impact on Clinical Outcome: Single-Institution Experience and Review of Literature

*Vincenzo Albanese[1], Francesco Certo[1], Massimiliano Visocchi[2], Giuseppe M.V. Barbagallo[1]*

BACKGROUND: **In multilevel degenerative conditions posterior approaches are often preferred, but anterior approaches provide comparable clinical results and better alignment. Anterior plating entails higher rates of soft tissue injuries and dysphagia, particularly in multilevel cases.**

**This study evaluates efficacy and safety of zero-profile devices in 3- and 4-level anterior cervical diskectomy and fusion, analyzing patients' clinical and radiologic long-term outcomes.**

METHODS: **We prospectively enrolled 24 patients with cervical spondylotic myeloradiculopathy who underwent 3- and 4-level anterior cervical diskectomy and fusion with the zero-profile device. Mean follow-up was 39 months (range 24–72). Nurick grading was used for myelopathy, Neck Disability Index and Visual Analog Scale scores for arm and neck pain, and Short Form 36 survey for physical and mental health status. Postoperative radiograph and computed tomography were obtained after surgery, at 6 and 12 months, and at last follow-up to assess fusion rate and complications. Cervical alignment was measured by Cobb angle. Incidence of postoperative dysphagia was monitored according to Bazaz dysphagia index.**

RESULTS: **On last computed tomography scan, fusion was present in 49% of spaces (40 of 82). Mean neck and arm pain visual analog scale decreased from 6.7–1.6 ($P < 0.01$) and 5.9–0.9 ($P < 0.01$), respectively. Improvements in the Short Form 36 survey and Neck Disability Index were documented ($P < 0.01$). Lordosis was restored in all patients. Five of 24 patients complained of mild dysphagia (20.8%): in three (12.5%) short-term dysphagia and in two (8.3%) medium-term dysphagia. No long-term dysphagia (≥6 months) was observed.**

CONCLUSION: **Anterior cervical diskectomy and fusion with a zero-profile device is effective and safe for 3- and 4-level cervical spondylotic myeloradiculopathy. It allows to restore cervical lordosis and achieve long-term satisfactory clinical outcome.**

## INTRODUCTION

Anterior cervical diskectomy and fusion (ACDF) is still considered a safe and effective option in the surgical treatment of single- and double-level cervical degenerative disk disease not suitable for disk arthroplasty.[1,2] Conversely, the best surgical strategy (i.e., anterior vs. posterior approach) in 3- or 4-level cases is not established and controversy remains.

Posterior approaches are usually performed to address multilevel neural compression, but their use is limited because of postoperative complications and loss of lordosis, particularly in noninstrumented procedures (i.e., laminectomy or laminotomy).[3]

Multilevel ACDF could be a viable alternative; indeed, a direct control of the anterior cervical column provides adequate neural decompression and allows maintenance or satisfactory restoration of cervical spine sagittal alignment.[3,4]

**Key words**
- ACDF
- Cage
- Cervical spondylosis
- Lordosis
- Plate
- Sagittal alignment
- Zero-profile

**Abbreviations and Acronyms**
ACDF: Anterior cervical diskectomy and fusion
CSM: Cervical spondylotic myeloradiculopathy
CT: Computed tomography
NDI: Neck Disability Index
PLL: Posterior longitudinal ligament
SD: Standard deviation
VA: Variable angle
VAS: Visual analog scale

*From the [1]Department of Neurological Surgery, Policlinico "G. Rodolico" University Hospital, Catania; and [2]Institute of Neurosurgery, Catholic University of Rome, Rome, Italy*

*To whom correspondence should be addressed: Giuseppe M.V. Barbagallo, M.D. [E-mail: giuseppebarbagal@hotmail.com]*

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Up to now, 3- and 4-level ACDF has not reached large consensus because a wide surgical exposure, with consequent visceral retraction, is required and long-segment anterior plating is often necessary if stand-alone interbody cages are implanted. Anterior plates in multilevel ACDF aim to increase fusion rates,[5-7] reduce instrument failures,[8] and prevent the development of late kyphotic deformities, as the plate allows to maintain or improve cervical lordotic alignment.[8,9]

However, anterior plating may also be associated with potential disadvantages and complications. Although modern anterior plates are low profile and soft tissue dissection, as well as microsurgery, allows adequate surgical exposure in multilevel cases without excessive retraction, the incidence of postoperative dysphagia after anterior plating, albeit transient, is still high.[10,11]

Integrated zero-profile cage-plate devices have been introduced in cervical spine surgery over the past years[12-16] with the aim to reduce morbidity associated with traditional anterior cervical plates, while maintaining the benefits of both intervertebral cages and plating.

The "Zero-P" cage-plate (DePuy Synthes, West Chester, Pennsylvania, USA) and its further evolution named "Zero-P VA" (variable angle) have been introduced to the market (Figure 1). Initial clinical reports on the use of these devices for ACDF showed satisfactory clinical and radiologic results in single- and double-level CSM.[2,13,17]

This prospective study focuses on the use of Zero-P and Zero-P VA devices in multilevel (i.e., 3- and 4-level) ACDF. Clinical and radiologic data of 24 patients were collected at long-term follow-up. Radiologic analysis focused on the comparison among preoperative, postoperative, and follow-up cervical sagittal alignment and investigated the correlation between clinical parameters and cervical sagittal alignement. Fusion rate and incidence and course of postoperative dysphagia were also analyzed.

## MATERIALS AND METHODS

### Patients

Between 2009 and 2013, we prospectively included 24 patients (14 male) who underwent 3- or 4-level ACDF with Zero-P devices (DePuy Synthes). Mean age was 58.4 (range 41–77), with a standard deviation of 10.6 years.

All patients suffered from symptomatic cervical spondylotic myeloradiculopathy (CSM), unresponsive to conservative treatment, involving 3 or 4 levels between C3–C4 and C6–C7. Clinical indications included radiculopathy, with or without neck pain, pyramidal signs (e.g., hyperreflexia, positive Babinski and/or Hoffmann signs, spasticity), gait, and urinary disturbances (Table 1). Patients with obvious signs of ossification of the posterior longitudinal ligament were considered not suitable for multilevel anterior approach and were treated with monolevel or multilevel somatectomies.

Fourteen patients (58.3%), with a mean age of 55.9 years, underwent 3-level surgery, whereas the remaining 10 patients (41.7%), with mean age of 61.7 years, underwent 4-level surgery. One patient included in the 3-level group was treated combining Zero-P devices with stand-alone cage: 1 stand-alone cage at C3–C4 and 2 Zero-P devices at C4–C5 and C5–C6.

Eighty-two cages were implanted in 24 patients. In 16 patients (66.7%, those operated before February 2013), the first type of cage-plate Zero-P device (i.e., the one with 4 screws) was used; in the remaining 8 patients (33.3%) the new Zero-P VA device was implanted (device with only 2 screws).

The C3–C4 level was treated in 18 patients (75%); C4–C5 and C5–C6 levels, respectively, were operated in all patients (100%) and C6–C7 level in 16 patients (66.7%).

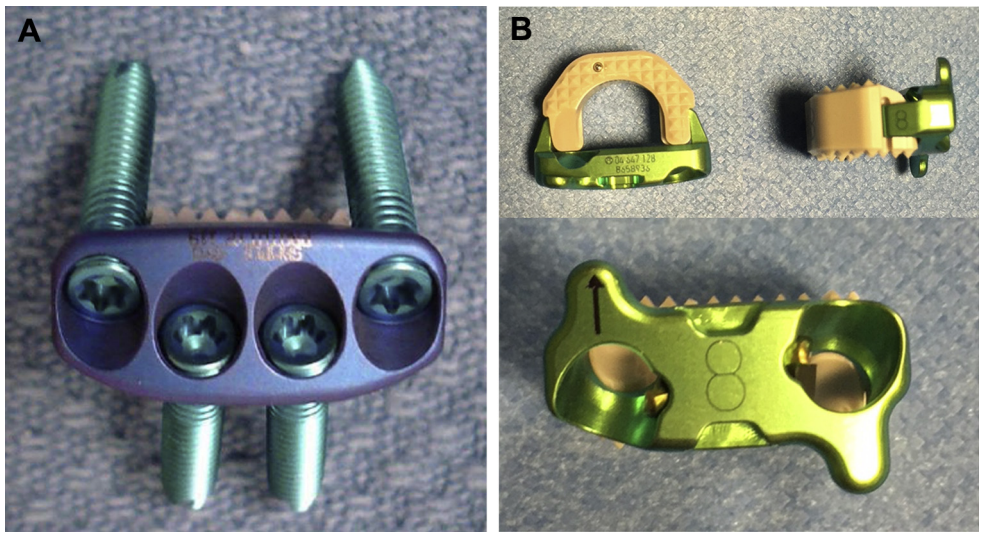


**Figure 1.** (**A**) Zero-P device. (**B**) Zero-P VA device.