

Feasibility of a New Philosophy of Stacking Single and Two-Level Cervical Plates End to End on the Same Vertebra Instead of a Three-Level Plate for Multilevel Anterior Cervical Fusion*

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Introduction

Anterior cervical decompression and fusion (ACDF) is a reliable and common surgical procedure producing satisfactory results in the treatment of cervical radiculopathy or myelopathy when conservative management fails¹⁻⁶. The addition of an anterior plate provides a rigid construct leading to increased stability. Single or two level anterior cervical fusion with anterior plating has yielded great success as shown by high fusion rates and minimal risks of plate failure^{5, 6}. Unfortunately, when anterior plating was translated to greater than two-level cervical spine surgeries, the fusion results did not reproduce similar findings as with shorter cervical fusions and there was inherently greater risk of plate failure due to the longer moment arm⁷⁻⁹. Other potential disadvantages of longer plates include decreased inherent stability and technical challenges of plate placement that could lead to misalignment and increased risk of adjacent segment degeneration and ossification due to settling and or placement too close to the adjacent disc space^{10, 11}.

Treatments of multilevel spondylosis have evolved to combine corpectomy and discectomy to enhance stability of the construct. The addition of an anterior plate further increases stability^{6, 12}. Single or two level anterior cervical constructs are inherently more stable and have higher fusion rates and minimal risks of plate failure compared with three or four-level constructs^{5, 6}. Other potential disadvantages of using three or four-level plates include: technical challenges of plate misalignment, extensile retraction of the esophagus possibly leading to dysphagia^{13, 14}, increased risk of adjacent segment degeneration and ossification due to settling and difficulty of manipulating the ends of a longer plate during placement^{10, 11}. Treating adjacent segment disease often necessitates an extensile approach to remove a previous three or four-level plate just to make room for the addition of a single-level plate.

We are proposing a new philosophy of cervical plating to decrease these disadvantages related to multilevel cervical plating by strategically stacking shorter cervical plates either single level or combined single and two-level plates rather than a single long three or four-level plate. This is a similar philosophy to combining a corpectomy and discectomy rather than a two-level corpectomy. Both patients were

informed about their case submission for publication and have agreed to this.

Illustrative Case #1 of an anterior single level plate caudad and two-level plate cephalad

This is a case of a 61 year old female with severe neck pain, radicular myelopathy and radiculitis from C4 to C7 with spondylosis (**Figure 1A-B**).

After a trial of conservative management she underwent C4-7 anterior cervical discectomies. We stacked a two-level plate from C4-C6 and a single level plate from C6-C7. This patient had mild dysphagia that resolved within her first two week follow-up, and she maintained radiographic evidence of fusion at her latest eight month radiographs with no neck complaints up to her latest clinical follow-up at twenty months.

Surgical Technique

Under general endotracheal anesthesia we performed left-sided anterior decompressions of each disc level at C4-5, C5-6, and C6-7



Figure 1A



Figure 1B

Case # 1: Sagittal (a) MRI image of the cervical spine demonstrating cord compression at C4-5, C5-6, and C6-7 levels. Lateral (b) plain radiograph showing advanced spondylosis between C4-C7.



Figure 2A

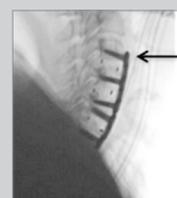


Figure 2B

Case # 1: Anteroposterior (a) and lateral (b) fluoroscopic views of the cervical spine showing stacked plates with black arrow showing the starting position of the screw into the vertebra.



Figure 3

Case # 2:

Preoperative sagittal MRI image of the cervical spine demonstrating cord compression at C4-5, C5-6, and C6-7 levels.

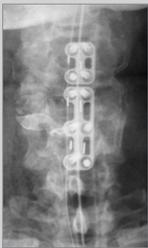


Figure 4a



Figure 4b

Case # 2:

Anteroposterior (a) and lateral (b) x-ray views of the cervical spine showing stacked plates.

and placed 8 mm PEEK (PEEK Optima, Invibio) cages in each disc space packed with corpectomized bone fragments and demineralized bone matrix (DBM). We placed a 37 mm two-level cervical plate with screws (SpineFrontier Inc., Invue Cervical Plate, Beverly, MA) from C4-C6. The plate design allowed clear visualization of the C4 endplate and C4-C5 disc space and PEEK cages. We placed a 20 mm plate at C6-C7 in line with the first plate. We then took AP and lateral intraoperative fluoroscopic views (*Figure 2a-b*). We added posterior supplemental lateral mass screws since this was the first patient to undergo this feasibility technique.

Illustrative Case # 2 of a single level plate cephalad and two-level plate caudad

A 64 year old male presented with severe neck pain and cervical radiculomyelopathy. He had spondylosis from C3-C6 (*Figure 3*). After a trial of conservative management we performed a C3-C6 anterior cervical discectomy and fusion. We stacked a single level cervical plate at C3-4 and a two-level cervical plate at C4-C6 using the technique-approach described. Post operative radiographic images showed very well positioned plates (*Figure 4a-b*). This patient reported minimal sensation of dysphagia during his first two days of recovery and no neck complaints at seven months postoperatively.

Discussion

The success of single-level ACDF has not been equaled when applied for greater than two levels^[5]. Catastrophic complications of long constructs causing airway compromise and death^[7], esophageal erosion from bone graft or plate irritation^[6] have been documented. Pistoning and failure of multilevel constructs and frequent pseudoarthrosis also occur^[9].

We are presenting a surgical technique philosophy that allows stacking of anterior cervical plates for multilevel cervical spine surgery where two short cervical plates are stacked end to end on the same vertebra, even after partial corpectomies, instead of using a three-level cervical plate. Using this new philosophy described in these two patients, the surgeon will have the opportunity for easier revision of adjacent segment disease by removing the appropriate one or two-level cervical plate instead of a long plate. No additional fluoroscopic time was required to place two plates as the second plate abutted the first under direct visualization on the intervening vertebra. This technique helped plate alignment as the second plate naturally aligned against the first. The risk of vertebral fracture

between the plates is as unlikely as it is for plating adjacent previously fused levels. Lastly, we avoided extensile retraction of the esophagus. These advantages will be improved with a plate designed for segmental multilevel application obviating the need for any longer plates, except for corpectomy.

Conclusion

We report a new philosophy of stacking two cervical plates end to end on the same vertebra after multilevel ACDF instead of a single three-level plate, thus demonstrating the feasibility of increased stability, increased fusion rates, improved technical ease of alignment and application for the surgeon, and ease of revision for an anticipated adjacent segment disease.

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