

# Pseudarthrosis Failures of Anterior Subaxial Cervical Spine Fusion Using a Plate with a Single Screw Per Vertebral Body: A Case Series

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## Key words

- ACDF
- Anterior fixation
- Cervical
- Complication
- Instrumentation
- Plating
- Pseudarthrosis
- Spine



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## INTRODUCTION

Anterior cervical fusion and discectomy has undergone change since its introduction more than 50 years ago (1, 6, 22). Initial results were met with high rates of pseudarthrosis and graft dislodgement (3, 6, 7, 22, 24); thus, customized anterior cervical plates were designed to provide internal stability (2, 4).

Although the role of plating for anterior cervical spine fusion remains in question (12, 18), their use has become widespread. In recent years, cervical plates have undergone significant modifications, so much so as to necessitate a system of nomenclature (11). Early (nonconstrained) plates had no mechanism for locking the vertebral body screw onto the plate, leading to screw backout failures (8, 15-17). In an effort to overcome this problem, several authors explored the virtues of bicortical anterior screws (5, 13, 17), which ultimately lost favor because of the potential risks of neurologic compromise (14). The problems of nonconstrained plates lead to the development of constrained cervical plates

■ **INTRODUCTION:** The UNIPLATE was developed to improve operative times and limit dissection at the lateral margins of the vertebral bodies. The distinguishing character of this plate is its thin design, which requires only one screw per vertebral level (monovertebral screw plate). Most cervical spine plates, in contrast, are designed for two screws per vertebral level (bivertebral screw plate). Limited reports of the biomechanical efficacy of the UNIPLATE are available, and to the authors' knowledge, this report represents the largest clinical study of its use.

■ **METHODS:** This is a retrospective chart-review study of consecutively treated patients without previous cervical spine surgery undergoing anterior cervical discectomy and fusion at one or two levels. The primary end point was symptomatic pseudarthrosis requiring revision surgery. Pseudarthrosis is defined as a failure of bony fusion on the operated level seen on thin-cut computed tomography scans performed on symptomatic patients. The rate of revision surgery caused by symptomatic pseudarthrosis was compared between patients undergoing one- and two-level fusion surgeries treated with UNIPLATE compared with other plates with two screws per vertebral level. The minimum follow-up was 18 months.

■ **RESULTS:** A total of 162 patients were identified, including 125 patients with one-level fusion and 37 patients with two-level fusion surgery. The median follow-up period was 3.3 years. A significantly greater incidence (odds ratio 10.2,  $P = 0.042$ ) of reoperation for symptomatic pseudarthrosis was noted for patients treated with the UNIPLATE (4 of 13, 31%) compared with patients treated with bivertebral screw plates (1 of 24, 2.5%). No significant difference in reoperation attributable to symptomatic pseudarthrosis was noted for different plating systems for one-level fusion surgeries.

■ **CONCLUSIONS:** There is an increased rate of reoperation for symptomatic pseudarthrosis after anterior cervical discectomy and fusion surgery with the use of a monovertebral screw semiconstrained plate, particularly in two-level fusion surgeries. Use of the UNIPLATE system has since been abandoned at our institution in favor of bivertebral screw plating systems.

with mechanisms to lock screws onto the plate (8, 14-16).

A constrained plate theoretically negates the problems of screw backout (8, 15). The major limitation of constrained plates is their stiffness. Such plates translate axial loading directly through the plate, thus shielding the interbody graft from axial loading stress. This stress-shielding results in less frequent incorporation of the graft

and a greater incidence of pseudarthrosis (9, 21). The problem of stress-shielding and pseudarthrosis leads to the development of dynamic plates. Dynamic plates permit movement in a rotational (flexion-extension) direction to increase axial loading on the graft in an effort to improve incorporation of the graft. These semiconstrained plates typically feature a screw-locking mechanism. Several such plates are now



**Figure 1.** The UNIPLATE has distinguishing characteristics of thin profile with a single, large screw per vertebral level. A one-level construct is shown.

commercially available for use in anterior cervical fusion procedures (8). Early non-constrained plates are no longer in use. A contemporary (and dynamic) version of the nonconstrained plate conception features screws with a locking mechanism and fixed position relative to the plate, with a mechanism built into the plate to allow translational (cephalad-caudad) motion.

One semiconstrained rotational plate (UNIPLATE; DePuy Orthopaedics, Inc., Warsaw, Indiana, USA) was developed to improve operative time and limit dissection at the lateral margins of the vertebral bodies anteriorly (8). The distinguishing character of the UNIPLATE (Figure 1) is its thin design requiring only one screw per vertebral level (hereafter referred to as “monovertebral screw plate”). Most cervical spine plates, in contrast, are designed for two screws per vertebral level (hereafter referred to as “bivertebral screw plate”). There are limited published reports of its biomechanical efficacy, which suggest it is equally effective as other semiconstrained rotational plates (8). In one study of a plate with a similar design, authors reported effective clinical results (23). Here, we describe our experience with this plating system.

**METHODS**

This was a retrospective chart-review study of 162 consecutive patients without previous cervical surgery undergoing one-level

**Table 1. One-Level Fusion Group Characteristics**

	Monovertebral Screw Plate	Bivertebral Screw Plate	P Value
Number	89	35	
Age, mean ± SEM	48.7 ± 11.5	51.4 ± 14.8	>0.2
Male gender	56 (63)	14 (40)	<0.03
Smoking	44 (49)	4 (11)	<0.01
Indication			
Radiculopathy	69 (78)	26 (74)	>0.8
Myelopathy	18 (20)	6 (17)	>0.8
Trauma	2 (2.2)	3 (8.6)	>0.1
Surgical level			
C3/4	7 (7.9)	5 (14)	>0.3
C4/5	10 (11)	3 (8.6)	>0.7
C5/6	46 (52)	14 (40)	>0.3
C6/7	26 (29)	12 (34)	>0.6
C7/T1	0 (0)	1 (2.9)	>0.2
Autograft	32 (36)	10 (29)	>0.5

Values are number (%) unless otherwise specified. Standard error of the mean (SEM).

(125 patients) or two-level (37 patients) anterior cervical discectomy and fusion by the senior authors (B.I.T., M.A.H.) at an academic medical center between September 2005 and December of 2008. During the study period, a semiconstrained variable angle monovertebral screw plate

(UNIPLATE) was used concurrently with a semiconstrained bivertebral screw plate (Reflex Hybrid; Stryker, Kalamazoo, Michigan, USA) and a dynamic nonconstrained plate (SWIFT, DePuy Orthopaedics Inc.) at the discretion of the senior authors. All anterior cervical fusion surgeries are

**Table 2. Two-Level Fusion Group Characteristics**

	Monovertebral Screw Plate	Bivertebral Screw Plate	P Value
Number	13	24	
Age, mean ± SEM	49.2 ± 10	51.4 ± 9.0	>0.5
Male gender	6 (46)	13 (54)	>0.7
Smoking	3 (23)	7 (29)	>0.9
Indication			
Radiculopathy	12 (92)	17 (71)	>0.2
Myelopathy	1 (7.7)	7 (29)	>0.2
Surgical levels			
C3/4 and C4/5	0 (0)	2 (8.3)	>0.5
C4/5 and C5/6	5 (38)	8 (33)	>0.9
C5/6 and C6/7	7 (54)	14 (58)	>0.9
C6/7 and C7/T1	1 (7.7)	0 (0)	>0.3
Autograft	12 (92)	10 (42)	<0.01

Values are number (%) unless otherwise specified. Standard error of the mean (SEM).

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