



Impact of Early and Late Complications on Patient Outcomes Following Surgical Treatment of Cervical Spondylotic Myelopathy Based on a Prospective Multicenter Study: The AOSpine N. Amer. CSM Study

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Introduction

The objective of this research was to assess the impact of complications on clinical and patient outcomes following surgical treatment of cervical spondylotic myelopathy (CSM).

Methods

The AOSpine North America CSM study is a recently completed prospective multicenter study of surgical treatment for CSM. Standardized forms were used for collection of adverse events, both early (within 30 days of surgery) and late (31 days–2 years after surgery) (**Figure 1**). Data collection was externally monitored to help ensure integrity and completeness. Outcomes measures included: Neck Disability Index (NDI), modified Japanese Orthopaedic Assessment (mJOA), SF36v2, and Nurick. Multivariate regression based predictor selection and general linear modeling were used to calculate associations between complications and patient outcomes.

Figure 1: Complication Categories

- Dural tear
- New iatrogenic fracture (intraop)
- Screw malposition
- Relevant bleeding complications
- Cortical blindness
- Periop worsening of myelopathy
- C5 radiculopathy
- New radiculopathy
- Dysphagia
- Dysphonia
- Stroke
- Deep venous thrombosis
- Thromboembolism
- Epidural hematoma
- Superficial infection
- Deep infection
- Cardiopulmonary complications
- Reoperation
- New intractable neck pain
- Graft site pain
- Axial pain
- Instability
- Progression of myelopathy
- Adjacent segment degeneration
- Graft site pain >6 months
- Graft dislodgement/migration
- Postoperative kyphosis
- Pseudoarthrosis
- Hardware failure
- Nonunion
- Other



Results

278 subjects were enrolled (mean age=56.3, SD=11.7; 59% males) (**Figures 2 and 3**). Of 306 adverse events, 64 were independently adjudicated to be early complications (**Figure 4A-B**) and 14 to be late complications (**Figure 5**). 44 subjects (15.8%) had one or more early complications, and 12 (4.3%) had one or more late complications. The

Figure 2: Patient Demographics

Parameter	N=302 Patients
Mean age, years (range)	57 (29-86)
Gender-female	124 (41%)
Smoking	76 (25%)
Mean body mass index (range)	29.0 (17.2 – 53.1)
Prior surgery*	17 (6%)
CSM severity**	
Mild (mJOA 15-17)	99 (33%)
Moderate (mJOA 12-14)	111 (37%)
Severe (mJOA <12)	92 (30%)

*Cervical surgery, not for myelopathy
**mJOA = Modified Japanese Orthopaedic Association score



Figure 3: Surgical Summary

Parameter	N=302 Patients
Surgical approach	
Anterior only	176 (58%)
Posterior only	107 (36%)
Anterior-Posterior	19 (6%)
Laminoplasty	38 (13%)
Corpectomy	53 (18%)
Number of spinal levels (SD)	3.9 (1.3)



extent of improvement in mJOA was negatively associated with the presence of early and late complications (P=0.0422). Both subjects with early and late complications experienced poorer results than subjects with no

Figure 4A: Peri-operative Complications

Complication	Total (%)	Minor	Major
Cardiopulmonary	10 (3.3)	9	1
Infection			
Superficial	7 (2.3)	5	2
Deep	2 (0.7)		2
Dysphagia/dysphonia	9 (3.0)	9	
C5 radiculopathy/palsy	5 (1.7)	4	1
Worsened myelopathy	4 (1.3)		4
Radiculopathy/palsy (not C5)	3 (1.0)	3	
Epidural/wound hematoma	3 (1.0)	1	2
Durotomy	3 (1.0)	3	
Instrumentation malposition/migration	3 (1.0)	2	1

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Figure 4B: Peri-operative Complications (cont)

Complication	Total (%)	Minor	Major
Renal complications	2 (0.7)		2
Worsened axial neck pain	2 (0.7)	2	
Altered mental status	2 (0.7)	1	
Death	1 (0.3)		1
Stroke	1 (0.3)		1
New neuro deficit (other)	1 (0.3)		1
Pulmonary embolism	1 (0.3)		1
Reoperation (NOS)	1 (0.3)		1
Pneumonia	1 (0.3)	1	
Dysphonia	1 (0.3)		1
Wound dehiscence	1 (0.3)		1
Miscellaneous	10 (3.3)	8	2
Total	73 (24.2)	48 (15.9)	25 (8.3)



Figure 5: Delayed Complications (31 d–2 yrs)

Complication	Total (%)	Minor	Major
Pseudarthrosis	5 (1.8)	2	3
Post-op deformity (kyphosis)	2 (0.7)	1	1
Symptomatic adjacent level disease	2 (0.7)	1	1
Instrumentation/graft migration	2 (0.7)	2	
Instrumentation failure	1 (0.4)	1	
Superficial infection	1 (0.4)	1	
Delayed dysphagia	1 (0.4)		1
Number of patients affected (%)	12 (4.4)	7 (2.5)	6 (2.2)



complications. Moreover, improvement in NDI was also negatively associated with the presence of complications (P=0.0036). However, only early complications impacted NDI

outcomes. Subjects without early complications experienced significant improvement in NDI (12.89, 95% CI=10.45–15.33). In contrast, subjects with early complications did not experience improvement in NDI (mean change=3.32, 95% CI=-2.50-9.14). No association between complications and improvements in SF36v2 or Nurick were identified.

Conclusions

These data suggest possible impact of complications on clinical outcomes following surgical treatment for CSM based on the NDI and mJOA, but not based on the SF36 or Nurick.

Learning Objectives

1. Improved understanding of the complication rates associated with operative treatment for cervical spondylotic myelopathy.
2. Appreciation of the possible impact of complications on the degree of improvement of outcomes measures following surgical treatment for cervical spondylotic myelopathy.

Acknowledgements

- Study is funded by AO Spine North America, a non-for-profit organization for excellence in spine.

