

# Correlation of Posterior Occipitocervical Angle and Surgical Outcomes for Occipitocervical Fusion

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## Abstract

**Study Type** Retrospective cohort study.

**Introduction** Craniocervical instability is a surgical disease, most commonly due to rheumatoid arthritis, trauma, erosive pathologies such as tumors and infection, and advanced degeneration. Treatment involves stabilization of the craniovertebral junction by occipitocervical instrumentation and fusion. However, the impact of the fixed occipitocervical angle on surgical outcomes, in particular the need for revision surgery and the incidence of dysphagia, remains unknown. Occipitocervical fusions (OCFs) at a single institution were reviewed to evaluate the relationships between postoperative neck alignment, the need for revision surgery, and dysphagia.

**Objective** The objective of this study is to determine whether an increased posterior occipital cervical angle results in an increase in the need for revision surgery, and secondary, dysphagia.

**Methods** A retrospective review of spinal surgery patients from January 2007 to June 2013 was conducted searching for patients who underwent an occipitocervical instrumented fusion utilizing diagnostic and procedural codes. Specifically, a current procedural code of 22590 (arthrodesis, posterior technique [craniocervical]) was queried, as well those with a description of “craniocervical” or “occipitocervical” arthrodesis. Ideal neck alignment before rod placement was judged by the attending surgeon. A review of all cases for revision surgery or evidence of dysphagia was then conducted.

**Results** From January 2007 to June 2013, 107 patients were identified (31 male, 76 female, mean age 63). Rheumatoid arthritis causing myelopathy was the most common indication for OCF, followed by trauma. Twenty of the patients were lost to follow-up and seven died within the perioperative period. Average follow-up for the remaining 80 patients was 16.4 months. The mean posterior occipitocervical angle (POCA), defined as the angle formed by the intersection of a line drawn tangential to the posterior aspect of the occipital protuberance and a line determined by the posterior aspect of the facets of the third and fourth cervical vertebrae, calculated after stabilization, was 107.1 degrees (range, 72–140 degrees). Reoperation was required in 11 patients (11/107, 10.3%). The

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mean POCA for the reoperation group was 109.5 degrees (range, 72–123) and was not significantly different than patients not requiring reoperation (106.5,  $p > 0.05$ ). However, for all pathologies excluding infection as a cause for reoperation, the mean POCA was significantly higher, 115.14 degrees ( $p = 0.039$ ) (►Table 1). Seven patients (6.5%) complained of dysphagia postoperatively with a significantly higher POCA of 115 degrees ( $p = 0.039$ ). Of these seven patients, six underwent posterior-only procedures. One patient underwent anterior and posterior procedures for a severe kyphotic deformity. The dysphagia resolved in six patients over a mean of 3 weeks (range, 2–4 weeks). One patient, whose surgery was posterior only, required the insertion of a gastrostomy tube.

**Conclusions** An elevated POCA may result in need for reoperation due to increased biomechanical stress upon adjacent segments or the construct itself due to flexion in an attempt to maintain forward gaze. Further, an elevated POCA seems to also correlate with a higher incidence of dysphagia. Further investigation is necessary to determine the ideal craniocervical angle which is likely individualized to a particular patient based on global and regional spinal alignments.

**Table 1** Comparison of occipitocervical fusion patient groups

	Revision	No revision	<i>p</i>
<i>N</i>	11 (10%)	96 (89%)	—
POCA	Mean: 109.5 Range: 72–123	Mean: 107.1 Range: 85–141	0.23
	Revision (excluding infection as indication)	No revision	
Adjacent level disease	2 (1.8%)		
Instrumentation failure	5 (4.7%)		
Total	7 (6.5%)	94 (88%)	
POCA (degrees)	Mean: 115 Range: 80–136	Mean: 107.1 Range: 85–141	0.039

Note: When patients who underwent revision surgery for reasons other than infection (adjacent segment degeneration or instrumentation failure), a significantly higher POCA (115 degrees,  $n = 0.039$ ) was found.

#### Disclosures

Christopher M. Maulucci, none

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#### Note

This study has been approved by the institutional review board (IRB) of Thomas Jefferson University.

#### References

- Anderson RC, Kan P, Gluf WM, Brockmeyer DL. Long-term maintenance of cervical alignment after occipitocervical and atlantoaxial screw fixation in young children. *J Neurosurg* 2006;105 (1, Suppl)55–61
- Ataka H, Tanno T, Miyashita T, Isono S, Yamazaki M. Occipitocervical fusion has potential to improve sleep apnea in patients with

- rheumatoid arthritis and upper cervical lesions. *Spine (Phila Pa 1976)* 2010;35(19):E971–E975
- 3 Bagley CA, Witham TF, Pindrik JA, et al. Assuring optimal physiologic craniocervical alignment and avoidance of swallowing-related complications after occipitocervical fusion by preoperative halo vest placement. *J Spinal Disord Tech* 2009;22(3):170–176
  - 4 Bhatia R, Desouza RM, Bull J, Casey AT. Rigid occipitocervical fixation: indications, outcomes, and complications in the modern era. *J Neurosurg Spine* 2013;18(4):333–339
  - 5 Deutsch H, Haid RW Jr, Rodts GE Jr, Mummaneni PV. Occipitocervical fixation: long-term results. *Spine (Phila Pa 1976)* 2005;30(5):530–535
  - 6 Dickman CA, Papadopoulos SM, Sonntag VK, Spetzler RF, Rekate HL, Drabier J. Traumatic occipitocervical dislocations. *J Spinal Disord* 1993;6(4):300–313
  - 7 Henderson FC, Geddes JF, Crockard HA. Neuropathology of the brainstem and spinal cord in end stage rheumatoid arthritis: implications for treatment. *Ann Rheum Dis* 1993;52(9):629–637
  - 8 Izeki M, Neo M, Ito H, et al. Reduction of atlantoaxial subluxation causes airway stenosis. *Spine (Phila Pa 1976)* 2013;38(9):E513–E520
  - 9 Izeki M, Neo M, Takemoto M, et al. The O–C2 angle established at occipito-cervical fusion dictates the patient's destiny in terms of postoperative dyspnea and/or dysphagia. *Eur Spine J* 2014;23(2):328–336
  - 10 Kawaida H, Sakou T, Morizono Y. Vertical settling in rheumatoid arthritis. Diagnostic value of the Ranawat and Redlund-Johnell methods. *Clin Orthop Relat Res* 1989;(239):128–135
  - 11 Lee SC, Chen JF, Lee ST. Clinical experience with rigid occipitocervical fusion in the management of traumatic upper cervical spinal instability. *J Clin Neurosci* 2006;13(2):193–198
  - 12 Matsunaga S, Ijiri K, Koga H. Results of a longer than 10-year follow-up of patients with rheumatoid arthritis treated by occipitocervical fusion. *Spine (Phila Pa 1976)* 2000;25(14):1749–1753
  - 13 Miyata M, Neo M, Fujibayashi S, Ito H, Takemoto M, Nakamura T. O–C2 angle as a predictor of dyspnea and/or dysphagia after occipitocervical fusion. *Spine (Phila Pa 1976)* 2009;34(2):184–188
  - 14 Miyoshi K, Nakamura K, Haga N, Mikami Y. Surgical treatment for atlantoaxial subluxation with myelopathy in spondyloepiphyseal dysplasia congenita. *Spine (Phila Pa 1976)* 2004;29(21):E488–E491
  - 15 Moskovich R, Crockard HA, Shott S, Ransford AO. Occipitocervical stabilization for myelopathy in patients with rheumatoid arthritis. Implications of not bone-grafting. *J Bone Joint Surg Am* 2000;82(3):349–365
  - 16 Nockels RP, Shaffrey CI, Kanter AS, Azeem S, York JE. Occipitocervical fusion with rigid internal fixation: long-term follow-up data in 69 patients. *J Neurosurg Spine* 2007;7(2):117–123
  - 17 Ota M, Neo M, Aoyama T, et al. Impact of the O–C2 angle on the oropharyngeal space in normal patients. *Spine (Phila Pa 1976)* 2011;36(11):E720–E726
  - 18 Riel RU, Lee MC, Kirkpatrick JS. Measurement of a posterior occipitocervical fusion angle. *J Spinal Disord Tech* 2010;23(1):27–29
  - 19 Sandhu FA, Pait TG, Benzel E, Henderson FC. Occipitocervical fusion for rheumatoid arthritis using the inside-outside stabilization technique. *Spine (Phila Pa 1976)* 2003;28(4):414–419
  - 20 Singh SK, Rickards L, Apfelbaum RI, Hurlbert RJ, Maiman D, Fehlings MG. Occipitocervical reconstruction with the Ohio Medical Instruments Loop: results of a multicenter evaluation in 30 cases. *J Neurosurg* 2003;98 (3, Suppl)239–246
  - 21 Sunahara N, Matsunaga S, Mori T, Ijiri K, Sakou T. Clinical course of conservatively managed rheumatoid arthritis patients with myelopathy. *Spine (Phila Pa 1976)* 1997;22(22):2603–2607, discussion 2608
  - 22 Vaccaro AR, Lim MR, Lee JY. Indications for surgery and stabilization techniques of the occipito-cervical junction. *Injury* 2005;36 (Suppl 2):B44–B53
  - 23 Visocchi M, Di Rocco F, Meglio M. Craniocervical junction instability: instrumentation and fusion with titanium rods and sublaminar wires. Effectiveness and failures in personal experience. *Acta Neurochir (Wien)* 2003;145(4):265–272, discussion 272
  - 24 Wang CS, Liu MJ, Lin JH, Xu WH, Luo HB. One stage anterior-posterior approach for traumatic atlantoaxial instability combined with subaxial cervical spinal cord injury. *Chin J Traumatol* 2011;14(3):137–142
  - 25 Winegar CD, Lawrence JP, Friel BC, et al. A systematic review of occipital cervical fusion: techniques and outcomes. *J Neurosurg Spine* 2010;13(1):5–16