

# UCSF

## UC San Francisco Previously Published Works

### Title

Hypoglossal Nerve Palsy After Cervical Spine Surgery

### Permalink

<https://escholarship.org/uc/item/3bq1x78s>

### Journal

Global Spine Journal, 7(1\_suppl)

### ISSN

2192-5682

### Authors

Ames, Christopher P

Clark, Aaron J

Kanter, Adam S

et al.

### Publication Date

2017-04-01

### DOI

10.1177/2192568216687307

### Copyright Information

This work is made available under the terms of a Creative Commons Attribution-NonCommercial-NoDerivatives License, available at

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Peer reviewed

# Hypoglossal Nerve Palsy After Cervical Spine Surgery

Global Spine Journal  
2017, Vol. 7(1S) 37S-39S  
© The Author(s) 2017  
Reprints and permission:  
sagepub.com/journalsPermissions.nav  
DOI: 10.1177/2192568216687307  
journals.sagepub.com/home/gsj



Christopher P. Ames, MD<sup>1</sup>, Aaron J. Clark, MD, PhD<sup>1</sup>,  
Adam S. Kanter, MD<sup>2</sup>, Paul M. Arnold, MD, FACS<sup>3</sup>,  
Michael G. Fehlings, MD, PhD<sup>4</sup>, Thomas E. Mroz, MD<sup>5</sup>,  
and K. Daniel Riew, MD<sup>6,7</sup>

## Abstract

**Study Design:** Multi-institutional retrospective study.

**Objective:** The goal of the current study is to quantify the incidence of 2 extremely rare complications of cervical spine surgery; hypoglossal and glossopharyngeal nerve palsies.

**Methods:** A total of 8887 patients who underwent cervical spine surgery from 2005 to 2011 were included in the study from 21 institutions.

**Results:** No glossopharyngeal nerve injuries were reported. One hypoglossal nerve injury was reported after a C3-7 laminectomy (0.01%). This deficit resolved with conservative management. The rate by institution ranged from 0% to 1.28%. Although not directly injured by the surgical procedure, the transient nerve injury might have been related to patient positioning as has been described previously in the literature.

**Conclusions:** Hypoglossal nerve injury during cervical spine surgery is an extremely rare complication. Institutional rates may vary. Care should be taken during posterior cervical surgery to avoid hyperflexion of the neck and endotracheal tube malposition.

## Keywords

cervical spine, complications, hypoglossal palsy, glossopharyngeal palsy, retrospective

## Introduction

Quantifying rare complications is critical for comprehensive risk profiling of particular treatment modalities and counseling patients.<sup>1</sup> Persistent deficits of the hypoglossal (CN XII) and glossopharyngeal (CN IX) nerves can be significant. By providing motor innervation to the tongue, the hypoglossal nerve is critical for speech and swallowing. Deficits of the nerve are manifested by dysphagia, dysarthria, and ipsilateral tongue deviation. The glossopharyngeal nerve provides motor, sensory, and parasympathetic innervation to the tongue, pharynx, and hypopharynx. Palsy is characterized by decreased taste and sensation in the posterior third of the tongue and an impaired gag reflex. Postoperative hypoglossal nerve palsy has very rarely been reported after anterior cervical discectomy and fusion procedures as well as corpectomy.<sup>2-4</sup> Hypoglossal nerve palsy has also been reported as a rare complication after posterior cervical spine surgery.<sup>5-7</sup> To the authors' knowledge, there have been no reports of new glossopharyngeal nerve deficits after cervical spine surgery. The goal of the current multi-institutional study was to analyze a very large number of patients in an attempt to quantify incidence rates of these rare complications.

## Methods

We have conducted a retrospective multicenter case-series study involving 21 high-volume surgical centers from the AOSpine North America Clinical Research Network, selected for their excellence in spine care and clinical research infrastructure and experience. Medical records for 17 625 patients who received cervical spine surgery (levels from C2 to C7)

<sup>1</sup> University of California, San Francisco, CA, USA

<sup>2</sup> University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

<sup>3</sup> Kansas University Medical Center, Kansas City, KS, USA

<sup>4</sup> Toronto Western Hospital, Toronto, Ontario, Canada

<sup>5</sup> Cleveland Clinic, Cleveland, OH, USA

<sup>6</sup> Columbia University, New York, NY, USA

<sup>7</sup> The Spine Hospital at NY-Presbyterian/Allen, New York, NY, USA

## Corresponding Author:

Christopher P. Ames, Department of Neurological Surgery, University of California, San Francisco, 505 Parnassus Avenue, Room M779, San Francisco, CA 94143-0112, USA.

Email: amesc@neurosurg.ucsf.edu



**Table 1.** Comparison of the Clinical Characteristics of the Current Case and Previously Reported Cases of Hypoglossal Nerve Palsy After Cervical Spine Surgery.

Reference	Incidence	Operation	Permanent (Yes/No)	Notes
Park et al (2007) <sup>3</sup>	1/15	C2/3, 3/4, 4/5 ACDF	Yes	All upper cervical anterior operations
Park et al (2011) <sup>10</sup>	NA	C3/4 ACDF	Yes	
Yasuda et al (2015) <sup>2</sup>	NA	C3/4 ACDF	No	
Saunders et al (1991) <sup>4</sup>	1/40	NR	Yes	All corpectomy
Sengupta et al (1999) <sup>9</sup>	NA	C2-5 corpectomy	Yes	
Grob et al (1991) <sup>12</sup>	1/161	C1/2 transarticular	No	All transarticular screws
Hong et al (2006) <sup>7</sup>	NA	C1-2 Harms	No	
Kang et al (2013) <sup>5</sup>	NA	C3-6 laminectomy	Yes	
Park et al (2013) <sup>6</sup>	NA	1. C4/5 foraminotomy 2. C3-5 laminoplasty	No No	

Abbreviations: ACDF, anterior cervical discectomy and fusion; NA, not applicable; NR, not reported.

between January 1, 2005 and December 31, 2011, inclusive, were reviewed to identify occurrence of 21 predefined treatment complications. The complications included reintubation requiring evacuation, esophageal perforation, epidural hematoma, C5 palsy, recurrent laryngeal nerve palsy, superior laryngeal nerve palsy, hypoglossal or glossopharyngeal nerve palsy, dural tear, brachial plexopathy, blindness, graft extrusion, misplaced screws requiring reoperation, anterior cervical infection, carotid artery injury or cerebrovascular accident, vertebral artery injuries, Horner's syndrome, thoracic duct injury, tetraplegia, intraoperative death, revision of arthroplasty, and pseudo-meningocele. Trained research staff at each site abstracted the data from medical records, surgical charts, radiology imaging, narratives and other source documents for the patients who experienced one or more of the complications from the list. Data was transcribed into study-specific paper Case Report Forms (CRF). Copies of CRF forms were transferred to the AOSpine North America Clinical Research Network Methodological Core for processing, cleaning, and data entry.

Descriptive statistics were provided for baseline patient characteristics. Paired *t* test was used to analyze changes in clinical outcomes at follow-up compared with preoperative status.

This study was ethically approved by the institutional ethics committees at all participating sites.

## Results

Data was available from 8887 patients from 21 institutions. All patients had surgery for cervical spine pathologies. There were 0 postoperative glossopharyngeal nerve palsies. There was one new postoperative hypoglossal nerve palsy (0.01%). This patient had undergone a C3-7 posterior fusion for cervical myelopathy. The operative time was 165 minutes. The patient was managed conservatively and the deficit resolved. Per site, the incidence of hypoglossal nerve deficit ranged from 0% to 1.28%.

## Discussion

Hypoglossal nerve injuries after cervical spine surgery have rarely been reported as complications in the literature. To the

authors' knowledge, no studies have evaluated the incidence of glossopharyngeal nerve palsy after cervical spine surgery. To quantify the incidence of these rare complications, the current study evaluated for the first time a large, multi-institutional series of patients undergoing all cervical spine operations. In this series, there was 1 hypoglossal nerve palsy and no glossopharyngeal nerve palsies.

Injury to the hypoglossal nerve has been reported in several case reports and small series (Table 1). The course of the hypoglossal nerve places it at risk during cervical spine surgery. It has most commonly been reported as a sequela after anterior operations, in particular the high cervical levels. It exits the skull base through the hypoglossal canal and proceeds inferiorly in the carotid sheath. Above C1/2 it is connected fibrously to the vagus nerve (CN X). Below C1/2, it breaks away and travels between the internal carotid artery and the internal jugular vein. At C2/3, it courses medially where it may be at risk during anterior approaches as demonstrated in a cadaveric study.<sup>8</sup> Consistent with this, Park et al<sup>3</sup> reported 15 cases of high cervical operations (C2/3) with a high incidence of permanent hypoglossal nerve palsy (6.67%). Saunders et al<sup>4</sup> reported 1 permanent hypoglossal nerve palsy in 40 cases of corpectomy for cervical myelopathy (2.5%) but did not provide details of the exact procedure performed in that one patient. Sengupta et al<sup>9</sup> reported a second case of permanent deficit after C2-5 anterior corpectomy, which may have been related to dividing the nerve inadvertently while attempting to coagulate a suspected crossing vessel. Below C2/3, the hypoglossal takes a more lateral orientation and may not be at direct risk during anterior operations. However, deficits have been reported after C3/4 anterior operation and may be related to compression from excessive retraction.<sup>2,6,10</sup>

Hypoglossal nerve palsy has also been less commonly reported after C1/2 transarticular screw placement (Table 1). A cadaveric study demonstrated that the hypoglossal nerve lies immediately anterior to the lateral aspect of the C1 lateral mass (2-3 mm from the middle of the lateral mass) and the C1/2 facet and therefore may be at risk with anterior breaches if the screw is slightly laterally placed.<sup>11</sup> Grob et al<sup>12</sup> reported one hypoglossal nerve deficit after 161 consecutive cases (0.6%) that

was thought to be related to nerve irritation due to a screw that had breached the cortex anteriorly. The deficit resolved after the screw was revised. One report exists of a transient hypoglossal nerve injury after a C1 lateral mass screw placed as part of a posterior Harms construct.<sup>7</sup> Although final radiographs demonstrated good screw placement, the hypothesis was that the nerve may have been injured during drilling or tapping.

Interestingly, hypoglossal nerve injury has also been described after posterior operations involving the lower cervical spine (Table 1). Therefore, the surgery is not directly related to the damaged nerve. Kang et al<sup>5</sup> reported hypoglossal nerve palsy after a noninstrumented C3-6 laminectomy for myelopathy and suggested that the deficit may have been related to compression of the hypoglossal nerve against the mandible from neck flexion or from stretching of the nerve by the endotracheal tube. Likewise, Park et al<sup>6</sup> reported 2 cases of hypoglossal nerve palsies, which were also suggested to be related to excessive neck flexion. In the current series, the one reported hypoglossal nerve palsy was transient and occurred following a C3-7 posterior fusion. Anatomically, the hypoglossal nerve would not be at risk during this procedure. It is therefore possible that neck flexion or endotracheal tube compression may have been the cause. Neck flexion opens the interlaminar spaces as well as translates the posterior elements upward to facilitate screw trajectories in the setting of thoracic kyphosis. Nevertheless, care must be taken to avoid hyperflexion of the neck. The reported incidence in the current study is lower than previously reported. This is likely because of the fact that previous series have focused solely on procedures that place the hypoglossal nerve at specific risk; corpectomy, high anterior cervical operations, and transarticular fixation.

## Conclusions

In this large, multi-institutional study of cervical spine operations, 1 hypoglossal nerve palsy was observed (0.01%). This may have been related to endotracheal intubation. At the institutional level, the incidence ranged from 0% to 1.28%. Although theoretically placed at risk during cervical spine surgery, 0 glossopharyngeal injuries were reported. Care with intubation and neck flexion may help avoid this extremely rare complication.

## Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Christopher P. Ames reports grants from AOSpine North America during the conduct of the study, personal fees from DePuy, personal fees from Stryker, personal fees from Medtronic, personal fees from Biomet Spine, personal fees from Stryker, personal fees from Doctors Research Group, outside the submitted work, and in addition, Dr. Ames has a patent Fish & Richardson, P.C. issued; Aaron J. Clark reports grants from AOSpine North America during the conduct of the study; Michael G. Fehlings reports grants from AOSpine North America during the conduct of the study; Thomas E. Mroz reports other from AOSpine during the conduct of the study, personal fees from Stryker, personal fees from Ceramtec, other from Pearl Diver, outside the submitted work; and K. Daniel Riew reports personal fees from AOSpine International, other from Global Spine Journal, other from Spine Journal, other from Neurosurgery,

personal fees from Multiple Entities for defense, plaintiff, grants from AOSpine, grants from Cerapedics, grants from Medtronic, personal fees from AOSpine, personal fees from NASS, personal fees from Biomet, personal fees from Medtronic, nonfinancial support from Broadwater, outside the submitted work; Adam S. Kanter reports grants from AOSpine North America during the conduct of the study; Paul M. Arnold reports grants from AOSpine North America, during the conduct of the study; other from Z-Plasty, other from Medtronic Sofamore Danek, other from Stryker Spine, other from FzioMed, other from AOSpine North America, other from Life Spine, other from Integra Life, other from Spine Wave, other from MIEMS, other from Cerapedics, other from AOSpine North America, outside the submitted work.

## Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was sponsored by AOSpine North America Inc, a 501(c) 3 non-profit corporation.

## References

1. Saigal R, Clark AJ, Scheer JK, et al. Adult spinal deformity patients recall fewer than 50% of the risks discussed in the informed consent process preoperatively and the recall rate worsens significantly in the postoperative period. *Spine (Phila Pa 1976)*. 2015;40:1079-1085.
2. Yasuda T, Togawa D, Hasegawa T, et al. Hypoglossal nerve palsy as a complication of an anterior approach for cervical spine surgery. *Asian Spine J*. 2015;9:295-298.
3. Park SH, Sung JK, Lee SH, Park J, Hwang JH, Hwang SK. High anterior cervical approach to the upper cervical spine. *Surg Neurol*. 2007;68:519-524.
4. Saunders RL, Bernini PM, Shirreffs TG Jr, Reeves AG. Central corpectomy for cervical spondylotic myelopathy: a consecutive series with long-term follow-up evaluation. *J Neurosurg*. 1991;74:163-170.
5. Kang JH, Kim DM, Kim SW. Tapia syndrome after cervical spine surgery. *Korean J Spine*. 2013;10:249-251.
6. Park CK, Lee DC, Park CJ, Hwang JH. Tapia's syndrome after posterior cervical spine surgery under general anesthesia. *J Korean Neurosurg Soc*. 2013;54:423-425.
7. Hong JT, Lee SW, Son BC, Sung JH, Kim IS, Park CK. Hypoglossal nerve palsy after posterior screw placement on the C-1 lateral mass. Case report. *J Neurosurg Spine*. 2006;5:83-85.
8. Haller JM, Iwanik M, Shen FH. Clinically relevant anatomy of high anterior cervical approach. *Spine (Phila Pa 1976)*. 2011;36:2116-2121.
9. Sengupta DK, Grevitt MP, Mehdian SM. Hypoglossal nerve injury as a complication of anterior surgery to the upper cervical spine. *Eur Spine J*. 1999;8:78-80.
10. Park J, Ahn R, Weon Y, Yang D. Diagnosing Tapia syndrome using a videofluoroscopic swallowing study and electromyography after anterior cervical spine surgery. *Am J Phys Med Rehabil*. 2011;90:948-953.
11. Ebraheim NA, Misson JR, Xu R, Yeasting RA. The optimal transarticular C1-2 screw length and the location of the hypoglossal nerve. *Surg Neurol*. 2000;53:208-210.
12. Grob D, Jeanneret B, Aebi M, Markwalder TM. Atlanto-axial fusion with transarticular screw fixation. *J Bone Joint Surg Br*. 1991;73:972-976.