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Bilateral C5 Motor Palsy after Anterior Cervical Decompression and Fusion: A Case Report and Review of the Literature

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Abstract

Background
Bilateral C5 motor palsy is a rare but potentially debilitating complication after cervical spine decompression with very few reports in the published literature.

Purpose
To present a case of bilateral C5 motor palsy after anterior cervical decompression and fusion and discuss the incidence and risk factors of this complication.

Study Design/Setting
We report a case of a 57-year-old male who underwent a three level C3-C6 anterior cervical discectomy and fusion with instrumentation who developed a postoperative bilateral C5 motor palsy.

Methods
A review of the literature was performed regarding reports on and incidence of post-operative bilateral C5 palsy following either anterior or posterior cervical spine decompression.

Results
Bilateral C5 motor palsy is a rare complication of cervical spine decompression with an overall incidence of 0.38%. Although a group of risk factors have been suggested no single cause has been identified.

Conclusions
Bilateral C5 motor palsy is a rare but debilitating complication of cervical decompression.

Introduction

Postoperative paralysis of the upper extremities due to C5 palsy is a well-documented complication of decompression of the cervical spine. Unilateral C5 palsy is far more common than bilateral C5 palsy and, as such, little discussion has been dedicated to bilateral C5 palsy in the literature. We present a patient who underwent a three level anterior cervical discectomy and fusion (ACDF) for cervical stenosis who developed a postoperative bilateral C5 motor palsy as a starting point for reviewing the current literature on this condition.

Case Report

A 57-year-old right-hand-dominant male construction worker presented complaining of chronic neck pain that had recently progressed to include right arm weakness and right hand numbness. He reported weakness primarily with elbow flexion and shoulder abduction and reported numbness to his right second and third digits. Physical exam was notable for limited neck range of motion due to pain and stiffness, grade 4 strength to the right deltoid and biceps, and decreased sensation to the radial aspect of the volar forearm and second and third digits. The patient had
normal biceps, triceps, and patellar reflexes, no difficulty with tandem gait, and had a negative Spurling test. Radiographic examination revealed multilevel degenerative disc disease with extensive osteophyte formation and loss of natural lordosis (Figure 1A). MRI revealed multilevel cervical stenosis with diffuse disc herniations, worst at C3-4, C4-5, and C5-6 (Figure 1B, Figure 2).

The patient was indicated for a C3-4, C4-5, and C5-6 anterior cervical discectomy and instrumented fusion through a single transverse left-sided incision. A standard operative approach was utilized and the posterior longitudinal ligament was taken down. Prophylactic cervical foraminotomies were not performed as per surgeon protocol. Anterior instrumentation was done with a three level Medtronic Atlantis Translational Anterior Cervical Plate (Medtronic, Minneapolis, MN). Fusion was performed via insertion of 8mm, 9mm, and 9mm Medtronic PEEK in-
terbody devices filled with Cornerstone Fibular allo-
graft and ¼ of an extra small rhBMP-2 Infuse sponge
at C3-4, C4-5, and C5-6, respectively (Medtronic,
Minneapolis, MN). There were no intraoperative
complications and neuromonitoring of somatosenso-
ry evoked potentials (SSEPs), motor evoked poten-
tials (MEPs) and electromyography (EMGs) re-
mained stable throughout the procedure. Postopera-
tively the patient was placed on a twenty-four hour
intravenous steroid taper to decrease the risk dyspha-
gia and airway edema.

Immediately postoperatively the patient was noted to
be moving his upper extremities without difficulty.
At the four-hour postoperative check the patient was
noted to have bilateral grade 4 deltoid and biceps
strength. On postoperative day one, approximately
eighteen hours after surgery, the patient was noted to
have grade 2 bilateral deltoid strength and grade 3 bi-
lateral biceps strength. Sensation was intact to all up-
per extremity dermatomes. A postoperative MRI ob-
tained to better evaluate the neural structures
demonstrated appropriate hardware placement and
no signs of acute nerve injury. The patient was diag-
nosed with a bilateral, pure motor C5 palsy and was
placed on a second twenty-four hour intravenous steroid taper. Occupational and physical therapy
were consulted for assistance with ambulation and
self-care and the patient was discharged home on
postoperative day three. The delay in discharge was
primarily to initiate therapy and set up appropriate
home services given the anticipated needs for a pa-
tient with a bilateral upper extremity palsy.

The patient’s symptoms persisted for three months
postoperatively but were noted to be slowly improv-
ing at the six-month visit. At one year follow-up the
patient’s symptoms had completely resolved with no
residual deficits.

Discussion

Upper extremity paresis due to C5 palsy is a known
complication of surgical decompression of the cervi-
cal spine. A recent systematic review calculated the
average incidence of C5 palsy to be 7.7% and 7.8% for
anterior and posterior cervical decompression, re-
spectively.1 Multiple theories for the cause of C5 pal-
sy have been suggested in the literature. These have
included intraoperative iatrogenic nerve root injury,
the presence of a congenitally narrow C5-foramina,
and local postoperative repurfusion nerve root in-
juries.1-5 However, it is unknown at this time as to
why the C5 nerve root seems to be the most sensitive
to these phenomena. The most commonly cited and
accepted theory for C5 nerve palsy is the ‘tethering
effect’, whereby it is believed that an increase in pos-
terior shift of the thecal sac after decompression of
the spinal canal and restoration of anatomic lordosis
puts tension on the exiting C5 nerve root and, either
by ischemia or neuropraxia, causes injury.1-6-9 This
theory is further supported by the equivalent rates of
C5 palsy after both anterior and posterior cervical
decompression. While the two approaches vary in
technique, they both decompress the spinal canal
and restore lordosis allowing for posterior shift of the
thecal sac and tension on the C5 nerve root.

Documented risk factors for development of postop-
erative C5 palsy include ossification of the posterior
longitudinal ligament (OPLL), increased preopera-
tive spinal cord rotational deformity, a narrow C5
foramen, older age, increasing number of levels of
decompression, and preoperative myelomalacia.10-13
Although relatively rare, the economic and psychoso-
cial cost of a postoperative C5 palsy is significant. Pa-
tients with unilateral postoperative C5 palsy have
demonstrated reduced ability for self-care, reduced
quality of life, and have incurred increased medical
costs due to the need for outpatient physical and oc-
cupational therapy.14 Published recovery rates have
varied but appear to be dependent on the severity of
initial paralysis alone. Approximately 95% of patients
with grade 3 muscle strength or greater make a full
recovery while only 70% of patients with grade 2
muscle strength or lower recovered to functional sta-
tus.15 At this time there is no specific treatment op-
tion for C5 palsy that has been shown to improve or
accelerate recovery. Although steroid administration
and physical therapy directed at maintaining range of
motion are the mainstays of treatment, there is no lit-
erature to suggest that these modalities improve
long-term outcomes.

Bilateral C5 palsy represents a small subset of all
postoperative C5 palsies. David et al published the
first known case report in 2005 regarding a 48-year-old male who developed a bilateral C5 palsy after a C4-C7 ACDF, focusing on the proposed origins of postoperative C5 palsy. A systematic review of studies published between 1986 and 2002 on 7284 patients who underwent anterior or posterior cervical decompression reported an overall incidence of postoperative C5 palsy of 4.6% and noted that 8% of these were bilateral. Since then, a number of papers have reported varying incidences of bilateral postoperative C5 palsy after both anterior and posterior cervical decompression (Table 1). In a review of 199 ACDF procedures, Hashimoto et al reported a 1% incidence of bilateral C5 motor palsy. In a review of 1858 laminoplasty procedures, Imagama et al reported a 0.12% incidence of bilateral C5 palsy (17). While there is no statistically significant difference for the development of unilateral postoperative C5 palsy between anterior or posterior decompression, no similar statistical analysis has been performed regarding bilateral C5 palsy. Summation of the most recent data on bilateral C5 palsy suggests an incidence of 0.37%, representing 8.8% of all postoperative C5 palsies (Table 1). This is nearly identical to and thus confirms the incidence of 0.38% described by Sakura et al.

In reviewing the case in question in an attempt to determine the cause for this complication, the only identifiable preoperative risk factor for development of C5 palsy was the plan for a three level surgery. Our patient did not have any other risk factors such as OPLL, older age, cord-rotational abnormalities, myelomalacia, or a narrow C5 foramina. It is important to note that rhBMP-2 was used in an off-label fashion as a fusion aide in this case. BMP has been shown to increase fusion rates after multilevel ACDF. Conversely, BMP has also been shown to affect oligodendrocyte maturation and myelination, is known to penetrate the thecal sac in the presence of a nerve injury, and has been associated with complications in cervical spine surgery such as wound infection and dysphagia. However, a recent meta-analysis regarding complications of BMP use in cervical spine surgery found no statistically significant relationship between the use of BMP and the development of post-operative C5 palsy or any other neurological complication. Nonetheless, given the known effects of BMP on nerve cell function, further research into the potential relationship between BMP and postoperative C5-palsy is warranted.

The most likely etiology for this instance of bilateral C5 palsy was the aforementioned ‘tethering effect’. Our patient demonstrated a 12-degree increase in cervical lordosis (Figure 3) and a 0.9mm posterior

<table>
<thead>
<tr>
<th>Author</th>
<th>Surgical Technique</th>
<th>Total number of patients in study</th>
<th>Incidence of C5 Palsy (total number of C5 palsies)</th>
<th>Incidence of bilateral C5 Palsy (total number of bilateral C5 palsies)</th>
<th>Percent bilateral C5 palsy of all C5 palsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sakaura et al. 2003</td>
<td>ACDF, laminoplasty</td>
<td>7284</td>
<td>4.6% (335)</td>
<td>0.37% (27)</td>
<td>8.1% (27/335)</td>
</tr>
<tr>
<td>Hasegawa et al. 2007</td>
<td>ACDF, laminoplasty, laminectomy</td>
<td>857</td>
<td>5.7% (49)</td>
<td>0.58% (5)</td>
<td>10.2% (5/49)</td>
</tr>
<tr>
<td>Hashimoto et al. 2010</td>
<td>ACDF</td>
<td>199</td>
<td>8.5% (17)</td>
<td>1.0% (2)</td>
<td>10.2% (2/17)</td>
</tr>
<tr>
<td>Imagama et al. 2010</td>
<td>laminoplasty</td>
<td>1858</td>
<td>2.3% (43)</td>
<td>0.12% (2)</td>
<td>4.7% (2/43)</td>
</tr>
<tr>
<td>Kaneyama et al. 2010</td>
<td>laminoplasty</td>
<td>146</td>
<td>5.5% (8)</td>
<td>1.4% (2)</td>
<td>25.0% (2/8)</td>
</tr>
<tr>
<td>Nassr et al. 2012</td>
<td>Multilevel corpectomy, corpectomy with posterior fusion, posterior laminectomy and fusion, and laminoplasty</td>
<td>630</td>
<td>6.7% (42)</td>
<td>0.48% (2)</td>
<td>7.1% (3/42)</td>
</tr>
<tr>
<td>Summation (excluding Sakura et al.)</td>
<td></td>
<td>3690</td>
<td>4.3% (159)</td>
<td>0.38% (14)</td>
<td>8.8% (14/159)</td>
</tr>
</tbody>
</table>
shift of the cord after decompression (Figure 4), suggesting a possible stretch or transient ischemic injury to the bilateral C5 roots. While this does not represent an overly significant increase in restoration of cervical lordosis, given the absence of other risk factors it remains the most logical explanation. Thus it is important to recognize that while adequate decompression can restore cervical height and lordosis, it also has the potential to place the C5 nerve roots at risk for a traction injury. The difficulty then lies in determining who is at risk for nerve root injury and subsequently striking a balance between adequate decompression and protection from a potential traction-related palsy. Effective means for identifying patients at risk for C5 palsy, especially bilateral C5 palsy, have yet to be developed and represent an important future endeavor.

Conclusion

Bilateral C5 palsy is a rare although potentially debilitating complication of cervical decompression and fusion. Based on the recent literature the incidence of this complication is 0.37%, representing 8.8% of all postoperative C5 palsy. While the true cause is likely multifactorial, restoration of cervical height and lordosis after decompression can put the C5 nerve roots at risk for a traction-related injury. Patients who suffer from this complication have difficulty with postoperative self-care and activities of daily living and should be identified early on as requiring intensive outpatient therapy.

References


Disclosures & COI
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