C5 Nerve root palsies following cervical spine surgery: A review

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Abstract

Background: Cervical C5 nerve root palsies may occur in between 0% and 30% of routine anterior or posterior cervical spine operations. They are largely attributed to traction injuries/increased cord migration following anterior/posterior decompressions. Of interest, almost all studies cite spontaneous resolution of these deficits without surgery with 3–24 postoperative months.

Methods: Different studies cite various frequencies for C5 root palsies following anterior or posterior cervical spine surgery. In their combined anterior/posterior series involving C4-C5 level decompressions, Libelski et al. cited up to a 12% incidence of C5 palsies. In Gu et al. series, C5 root palsies occurred in 3.1% of double-door laminoplasty, 4.5% of open-door laminoplasty, and 11.3% of laminectomy. Miller et al. observed an intermediate 6.9% frequency of C5 palsies followed by posterior cervical decompressions and fusions (PCDF).

Results: Gu et al. also identified multiple risk factors for developing C5 palsies following posterior surgery; male gender, ossification of the posterior longitudinal ligament (OPLL), narrower foramina, laminectomy, and marked dorsal spinal cord drift. Miller et al. also identified an average $1918 increased cost for physical/occupational therapy for patients with C5 palsies.

Conclusions: The incidence of C5 root deficits for anterior/posterior cervical surgery at C4-C5 was 12% in one series, and ranged up to 11.3% for laminectomies, while others cited 0–30%. Although identification of preoperative risk factors for C5 root deficits may help educate patients regarding these risks, there is no clear method for their avoidance at this time.

Key Words: Anterior surgery, cervical, C5 root palsies, C4-C5 surgery, factors, posterior surgery, risk

INTRODUCTION

The risk of C5 palsies occurring following anterior, posterior, or circumferential spine surgery varies from 0% to 30%. Although there are multiple theories as to the etiology of these injuries, cord migration with resultant traction injury to the C5 nerve roots, particularly following surgery at the C4-C5 level, predominates. Despite the increased availability of multiple treatment strategies, if postoperative magnetic resonance (MR)
studies show no new focal lesion (e.g. hematomas/other), most would recommend nonoperative management as the majority of deficits spontaneously resolve over 3–24 postoperative months. Below we explore the relative frequencies, surgical etiologies, and risk factors leading to postoperative C5 palsies following cervical spine surgery.

**RISK OF C5 PALSY WITH ANTERIOR CERVICAL DECOMPRESSION**

C5 palsy in 32 patients undergoing extremely wide/asymmetric anterior decompression

Of 459 patients having anterior decompression/fusion at the C4-C5 level for cervical spondylotic myelopathy (CSM), Odate et al. found that 32 (7%) experienced postoperative C5 palsies [Tables 1 and 2].

They were divided into two groups (palsy side [n = 35] and nonpalsy side [n = 29]), and their clinical/radiographic studies were compared with 66 consecutive other patients who had the same procedures without C5 root deficits. They found that those with C5 palsies had smaller preoperative C4-C5 foramina, underwent more extensive/wider/asymmetric unilateral decompressions, and exhibited less anterior spinal cord shift.

The frequency of C5 root palsies utilizing different anterior cervical operations for csm; risk of C5 palsy lower with multilevel discectomies

Shamjii et al. compared the safety/efficacy of multiple anterior cervical approaches (decompressions/fusions) addressing CSM (e.g. excluding ossification of the posterior longitudinal ligament [OPLL], single level CSM) [Tables 1 and 2]. Utilizing 10 studies from MEDLINE and the Cochrane Collaboration Library (through 2012) that met inclusion criteria (at least 10 cases each), they compared: “Multiple discectomies with single or multiple corpectomy, multiple discectomies with discectomy-corpectomy hybrid, and multiple corpectomies with discectomy-corpectomy hybrid.” Patients having any of these three procedures improved (based upon the Japanese Orthopedic Association [JOA], Visual Analog Scale [VAS] scales), and experienced few complications. Moderate evidence favored multiple discectomies with single or multiple corpectomy (e.g. better outcomes and improved sagittal alignment), with a lower risk of C5 palsy. Furthermore, discectomy-corpectomy hybrid procedures were preferable to multiple corpectomies.

**Hybrid decompression/fusion vs. Plated three-level corpectomy for 4-segment CSM**

In 81 patients with 4-level CSM/kyphosis followed for at least 2 years, Odate et al. explored the efficacy/morbidity of hybrid decompressions/fusions (39 patients) vs. plated 3-level anterior corpectomy/fusion (ACF) (42 patients) [Tables 1 and 2]. The hybrid procedures included a plated two-vertebra ACF and single-level discectomy.

### Table 1: Frequency of reported C5 palsies following cervical surgery

| Author   | Surgery                                      | Total patients | Number C5 palsies (and/or %) |
|----------|----------------------------------------------|----------------|-----------------------------|
| Kanchiku et al. | AP Laminoplasty*                            | 43             | 3 (7)                       |
|          | Selective laminoplasty                       |                |                             |
|          | Anterior decompression/fusion                |                |                             |
| Lubelski et al. | AP Involving C4-C5 level | 98             | 12 (12)                     |
|          | Anterior decompression                       |                |                             |
|          | Posterior decompression                      |                |                             |
| Ohashi et al. | P Bilateral C4-C5 Foraminotomy/laminoplasty | 121            | 1.7%                        |
|          | Laminoplasty alone                          | 115            | 7.0%                        |
| Gu et al. | P Posterior decompressions                  |                |                             |
|          | Open-door laminoplasty                      |                | 5.8%                        |
|          | Double-door laminoplasty                    |                | 4.5%                        |
|          | Laminctomy                                  |                | 3.1%                        |
|          |                                               |                | 11.3%                       |
| Wu et al. | P Open-door laminoplasty                    | 102            | 16 (15.7)                   |
| Odate et al. | A Anterior cervical decompressions          | 459            | 32 (7)                      |
| Du et al. | P Multilevel CSM/kyphosis expanded laminectomies/foraminotomies/fusions | 43 | 0 (0) |
| Chang et al. | AP Anterior decompressions                  | 364            | 12 (3.3)                    |
|          | Posterior decompression                      |                | 0.7%                        |
|          | Combined procedures                          |                | 8.8%                        |
|          |                                               |                | 36.4%                       |
| Liu et al. | P Unilateral lateral mass fusion/contralateral hemilaminectomy | 145 | 0 (0) |
| Odate et al. | A Hybrid corpectomy/disk                    | 39             | 2 (3)                       |
|          | 3-Level corpectomy                          | 42             | 7 (17)                      |
| Eskander et al. | A Anterior disectomy/fusion C4-C6 Levels | 176            | 12 (6.8)                    |
| Chen et al. | P Hybrid laminoplasty                       | 15             | 1 (6.7)                     |
|          | With lateral mass fusion                    | 15             | 1 (6.7)                     |
|          | Lamoplasty alone                            |                |                             |
| Kim et al. | A Anterior corpectomy fusion                | 104            | 6 (5.8)                     |

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performed with stand-alone cage fixation. Halo braces were utilized in 9 (21%) of 42 patients undergoing plated 3-level ACF vs. none in the hybrid group. Advantages of the hybrid procedure included: Fewer construct failures (0% vs. 10%; e.g. graft/plate extrusions/ pseudarthrosis), and fewer C5 palsies (5% vs. 17%, respectively). Notably, postoperative C5 palsies occurred in: 25% of C3-C5 ACF, 19% of C4- C6 ACF, but only 11% of C4-C5 ACF/C6-7 discectomy.

Correlation between preoperative spinal cord rotation and postoperative C5 palsy for anterior cervical discectomy/fusion between the c4-c6 levels

In 176 patients undergoing anterior cervical discectomy/fusion (ACDF) between the C4-C6 levels, Eskander et al. correlated the degree of rotation of the cervical cord on MR scans with the 6.8% incidence of postoperative C5 palsies [Tables 1 and 2]. They found a significant relationship between the incidence of postoperative C5 palsies and greater degrees of rotation; 0° to 5° (mild Type I: 0 palsies in 159), 6° to 10° (moderate Type 2: 8 palsies of 13), and ≥11° (severe Type 3: 4 palsies of 4).

Analysis of C5 palsies after anterior cervical surgery

In Kim et al. series of 104 patients with CSM, cervical spondylotic myeloradiculopathy (CSM/R), and/or OPLL (vs. another 30 with radiculopathy only), 6 (5.8%) developed C5 palsies [Tables 1 and 2]. C5 palsies occurred in 3 of 76 (3.95%) patients with CSM, 1 of 6 (16.7%) with CSM/R, and 2 of 22 (9%) with OPLL, and followed 2 ACF, 3 ACDF, and 1 cage placement/no plate. For the four patients treated conservatively, three fully and one nearly completely resolved, while only one of the two patients undergoing additional foraminal decompression improved; in short, conservative treatment yielded better outcomes. Of interest, their postoperative X-rays showed increased lordosis at the surgical levels (average 6°), and an average increase of 8.2° in sagittal alignment (C3-C7).

Complications with three alternative anterior decompression/fusion techniques for CSM

When Liu et al. evaluated multilevel ACDF vs. hybrid construct vs. long corpectomy performed in 286 patients (166 M/120 F; average age 53.8 (range 33–74) years), 61% exhibited perioperative complications; graft migration/collapse/dislodgement, hoarseness, dysphagia, cerebrospinal fluid (CSF) fistulas, wound infections, and C5 palsies [Tables 1 and 2]. As anticipated, long corpectomy constructs yielded the highest complication rates, multilevel ACDF had the highest fusion rates, while cephalad C2-C4 procedures had the highest rates of hoarseness/dysphagia.

RISKS OF C5 PALSY WITH ANTERIOR VS. POSTERIOR CERVICAL SURGERY

C5 root injuries with anterior and posterior surgery in CSM patients averaging 79 years of age

Kanchiku et al. reviewed the frequency of C5 root injuries in 43 consecutive patients averaging 79 years of age undergoing cervical spine surgery for CSM [Tables 1 and 2]. Surgical procedures included: 21 laminoplasties (from C3 to C7), 13 selective laminoplasties (1 above/1 below the maximally compressed level), and 9 anterior decompressions/fusions; JOA recovery rates were comparable for all 3 groups. Postoperatively, they observed one wound infection, and three C5 palsies.

Comparing risks of C5 palsy in anterior ‘skip’ corpectomy vs. Posterior surgery for spondylotic myelopathy

Qian et al. compared the efficacy of multilevel anterior “skip” corpectomy vs. posterior cervical decompressions for 3 level CSM [Table 2]. For anterior vs. posterior procedures, average surgical times (2.5 and 2.1 h), and mean blood loss (250 and 380 cc) were, respectively, recorded. Postoperative complications following anterior procedures included 5 axial neck pain, 2 hoarseness, 2 mesh subsidence, and 2 plate/screw dislocations, while posterior morbidity included 15 with axial neck pain, 3 CSF leaks, and 2 C5 root palsies. Since JOA scores showed significantly higher recovery rates for anterior
The risk of C5 palsies occurring following cervical spine surgery varies from 0% to 30%. They typically result from traction injuries due to dorsal cord migration particularly involving surgery at the C4-C5 level. Most spontaneously resolve over 3-24 postoperative months. Below we explore the relative frequencies, surgical etiologies, and risk factors leading to postoperative C5 palsies following cervical spine surgery.

| Table 2: Summary of sections |
|-----------------------------|
| **Introduction**            | The risk of C5 palsies occurring following cervical spine surgery varies from 0% to 30%. They typically result from traction injuries due to dorsal cord migration particularly involving surgery at the C4-C5 level. Most spontaneously resolve over 3-24 postoperative months. Below we explore the relative frequencies, surgical etiologies, and risk factors leading to postoperative C5 palsies following cervical spine surgery. |
| **Risk of C5 Palsy with Anterior Cervical Decompression** | Summary: Odate et al. retrospectively analyzed the frequency of C5 palsies in 459 patients having C4-C5 anterior decompression/fusion for CSM; 32 experienced postoperative C5 palsies [Tables 1 and 2].[16] They were divided into two groups (palsy side [n = 35] and nonpalsy side [n = 29]), and their clinical/radiographic studies were compared with 66 consecutive other patients who had the same procedures without C5 root deficits; those with C5 palsies had smaller preoperative C4-C5 foramina, underwent more extensive/wider symmetric unilateral decompressions, and exhibited less anterior spinal cord shift. |
| **C5 Palsy in 32 Patients Undergoing Extremely Wide/Asymmetric Anterior Decompression** | The Frequency of C5 Root Palsies Utilizing Different Anterior Cervical Operations for CSM; Risk of C5 Palsy Lower with Multilevel Diskectomies | Summary: When Liu et al. evaluated multilevel ACDF vs. hybrid construct vs. long corpectomy performed in 286 patients, 61% exhibited peroperative complications; graft failures, hoarseness, dysphagia, cerebrospinal fluid (CSF) fistulas, wound infections, and C5 palsies [Tables 1 and 2].[11] |
| **Correlation Between Preoperative Spinal Cord Rotation and Postoperative C5 Palsy for ACDF Between the C4-C6 Levels** | Analysis of C5 Palsies After Anterior Cervical Surgery | Summary: In 176 patients undergoing ACDF between the C4-C6 levels, Eskander et al. correlated the degree of rotation of the cervical cord on MR scans with the 6.8% incidence of postoperative C5 palsies [Tables 1 and 2].[15] They found that more C5 palsies occurred with greater degrees of rotation; 0° to 5° (mild Type I: 0 palsies in 159), 6° to 10° (moderate Type 2: 8 palsies of 13), and ≥11° (severe Type 3: 4 palsies of 4) |
| **Complications with three Alternative Anterior Decompression/Fusion Techniques for CSM** | Summary: When Liu et al. evaluated multilevel ACDF vs. hybrid construct vs. long corpectomy performed in 286 patients, 61% exhibited peroperative complications; graft failures, hoarseness, dysphagia, cerebrospinal fluid (CSF) fistulas, wound infections, and C5 palsies [Tables 1 and 2].[11] |
| **Risks of C5 Palsy in 32 Patients Undergoing Extremely Wide/Asymmetric Anterior Decompression** | Summary: Lawrence et al. evaluated the pros and cons of anterior vs. posterior cervical surgical alternatives to address CSM involving more than 2 levels [Tables 1 and 2].[16] Upon reviewing the literature and other databases, only 8 of 135 studies met inclusion criteria. Since they observed comparable improvement in JOA scores for anterior or posterior surgery, and comparable rates of C5 palsies, they concluded there were no unique advantages to anterior vs. posterior cervical surgery for 2-level CSM |
| **Comparable Rates of C5 Palsy with Anterior vs. Posterior Cervical Surgery** | Summary: Chang et al. assessed the relative risk/frequency of C5 palsy following 364 anterior vs. posterior cervical surgery, and related this to the quality of life [Tables 1 and 2].[17] Twelve (3.3%) had postoperative C5 palsies; 0.7% followed anterior procedures (n = 2), 8.8% posterior procedures (n = 6), and 36.4% in combined anterior/posterior procedures (n = 4). C5 deficits also highly correlated with advanced age, type of cervical lesion, and surgery involving the C4-C5 level. |
| **Quantitative Measures and Frequency of C5 Palsy with Anterior vs. Posterior Cervical Surgery: Assessment of Risk Factors and Correlation with Quality of Life Measures** | Summary: In Kim et al. series of 104 patients with cervical spondylotic myelopathy (CSM), cervical spondylotic myeloradiculopathy (CSM/R), and/or ossification of the posterior longitudinal ligament (OPLL) (vs. another 30 with radiculopathy only), 6 (5.8%) developed C5 palsies [Tables 1 and 2].[19] These occurred in 3 of 76 (3.95%) patients with CSM, 1 of 6 (16.7%) with CSM/R, and 2 of 22 (9%) with OPLL, and followed 2 ACF, 3 ACDF, and 1 cage placement/no plate. Notably, conservative treatment yielded better outcomes; for 4 treated non-surgically, 3 fully or 1 nearly completely full recovered, while only 1 of the 2 patients having additional foraminal decompression improved |

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Summary: Gu et al. systematically utilized the PubMed, Embase, Web of Science, and Cochran CENTRAL databases to evaluate the incidence/risk factors contributing to C5 palsy following posterior cervical decompressive surgery [Tables 1 and 2]. They identified 25 out of 589 studies, which calculated a 5.8% incidence (95% CI: 4.4-7.2%) of C5 palsies following posterior cervical decompressions; 4.5% open-door laminoplasty, 3.1% double-door laminoplasty, and 11.3% for laminectomy. Risk factors contributing to C5 palsies included; spontaneous dorsal cord shift/root tethering, ischemia/reperfusion injury, and direct operative trauma.

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surgery, the authors concluded that “skip” corpectomy was more safe/effective vs. posterior surgery for CSM.

### Comparable rates of C5 palsy with anterior vs. Posterior cervical surgery

Lawrence et al. evaluated the pros and cons of anterior vs. posterior cervical surgical alternatives to address CSM involving more than 2 levels [Tables 1 and 2]. Upon reviewing the literature and other databases (e.g., GRADE [Grading of Recommendation Assessment, Development and Evaluation]/AHRQ [Agency for Healthcare Research and Quality through 9/2012]), they found that only 8 of 135 studies met inclusion criteria. These studies revealed comparable improvement in JOA scores for anterior or posterior surgery, and comparable rates of C5 palsies. Of interest, overall greater canal enlargement correlated with posterior operations. The concluded that there were no unique advantages to anterior vs. posterior cervical surgery for 2-level CSM.

### Quantitative measures and frequency of C5 palsy with anterior vs. posterior cervical surgery: Assessment of risk factors and correlation with quality of life measures

Chang et al. assessed the relative risk/frequency of C5 palsy following 364 anterior vs. posterior cervical surgery, and related this to the quality of life [Tables 1 and 2]. Twelve (3.3%) had postoperative C5 palsies; 0.7% followed anterior procedures \( n = 2 \), 8.8% followed posterior procedures \( n = 6 \), and 36.4% followed combined anterior/posterior procedures \( n = 4 \). Significant differences observed for the 12 patients with C5 palsies included...
the manual muscle test (MMT), the action research arm test (ARAT), the Jebsen test of hand function (JTHF), and the European quality of life-5 dimensions (EQ-5D). C5 deficits also highly correlated with: Advanced age, type of cervical lesion, and surgery involving the C4-C5 level.

The frequency of C5 palsy after multilevel anterior or posterior cervical surgery

Nassr et al. cited a 0–30% incidence of C5 palsies reported in the literature, but found 42 (6.7%) instances of C5 palsies following 650 (292 females/338 males; average age 58 years) consecutive multilevel ACF with/without posterior fusions vs. laminectomy/fusion or laminoplasty in their own series [Tables 1 and 2]. Their different frequencies of C5 deficits were not statistically significant and included laminectomy/fusion (9.5%), ACF/posterior fusion (8.4%), ACF alone (5.1%), and laminoplasty (4.8%). They also cited various etiologies for C5 palsies: Spontaneous dorsal cord shift/root tethering, ischemia/reperfusion injury, and direct operative trauma.

FREQUENCY OF C5 PALSYs WITH POSTERIOR CERVICAL SURGERY

C-5 palsy following posterior cervical decompressions/pedicle screw fusions

Nakashima et al. evaluated the unique radiographic risk factors (e.g. utilizing X-ray, MRI, computed tomography (CT)) for 10 (11.9%) of 84 (average age 60.1 years) patients who developed C5 palsies after undergoing posterior cervical decompressions/pedicle screw fusions [Tables 1 and 2]. Radiographic risk factors for C5 palsies included: Significant preoperative C4-C5 kyphosis, significantly smaller preoperative C4-C5 foramina (e.g. 2.2–2.3 mm on the palsy side), the presence of OPLL, and the extent of postoperative posterior cord shift at the C4-C5 level. Note that with conservative therapy, seven fully recovered.

C-5 palsy following posterior cervical decompressions/vertex rod-eyelet spinous process fusion (without lateral mass screws)

In Epstein’s series (in preparation), 3 (3.3%) of 92 patients undergoing 1-3 level laminectomies (mean 2.5)/and 5-9 level posterior instrumented fusions (average 7.6 level vertex rod/eyelet/braided cable/spinous process fusions) for CSM/OPLL developed delayed postoperative C5 palsies [Tables 1 and 2]. Of interest, the two bilateral and one unilateral C5 palsies occurred in a delayed fashion on days 2, 3, and 5, and all involved C4-C5 laminectomies (e.g. laminectomy C4-C5 (1 patient), laminectomy C4, C5, C6 (2 patients).

C5 palsy with open-door vs. French-door laminoplasty for CSM

Wang et al. compared the relative efficacy/risk/complications of performing open-door laminoplasty (ODL) vs. French-door laminoplasty (FDL) for treating CSM. Four comparative trials were studied [Table 2]. Although the postoperative JOA scores were higher for ODL vs. FDL, the following variables were comparable: operative time, intraoperative blood loss, total complication rate, postoperative cervical lordosis, range of motion, and postoperative palsy.

C5 root palsy following expansile open-door laminoplasty for CSM

Wu et al. retrospectively analyzed the risk factors resulting in the development of C5 palsies following open-door laminoplasties for CSM [Tables 1 and 2]. Of 102 patients, 16 (15.7%) had C5 palsies (13 men and 3 women, average age 62.8 years) vs. 86 without palsies (63 men and 23 women, average age 57.8 years) [Tables 1 and 2]. Factors predisposing to C5 palsies included: more narrowed width of the intervertebral foramen (WIF), anterior protrusion of the superior articular process (APSAP), a high-signal intensity zone C3-C5 (HIZ: C5-C5), and OPLL; of interest, both groups demonstrated comparable posterior shift of the spinal cord (PSSC).

More C5 root palsies following laminectomy and fusion for csm vs. Modified plate-only open-door laminoplasty for CSM

Yang et al. evaluated the extent of decompression and avoidance of complications (including C5 root palsies) for 141 CSM patients undergoing modified plate-only laminoplasty vs. laminectomy and fusion [Tables 1 and 2]. For both groups, postoperative T2-weighted MR scans at the three most compromised levels revealed significant expansion of the dural cross-sectional area, and dorsal spinal cord drift (but laminectomies resulted in more extensive decompressions). Although patients from both groups exhibited comparable postoperative JOA scores, the plate-only laminoplasty patients showed more improvement on the Neck Dysfunction/Disability Index (NDI)/VAS, demonstrated greater preservation of cervical mobility, and exhibited fewer postoperative C5 palsies.

RISK FACTORS, EARLY DETECTION, PREDICTION AND PREVENTION OF C5 PALSYs

Risk factors for C5 palsy; cervical laminectomy/fusion width and extent of dorsal cord migration

Radcliff et al. evaluated 17 patients with CSM/OPLL who developed C5 palsies following cervical laminectomy/fusion (CLF) accompanied by wide MR-documented laminectomy troughs [Tables 1 and 2]. Patients were compared with eight CSM/OPLL controls also undergoing CLF, but with normal troughs and without C5 palsies. Unique postoperative MR findings for those with C5 palsies included on average, greater dorsal cord drift at the C3-C6 levels (C3 [4.2 vs. 2.2 mm], C4 [4.6 vs.
2.8 mm), C5 [5.1 vs. 2.4 mm], and C6 [5.2 vs. 2.4 mm]), wider C5 laminectomy troughs (17.9 vs. 15.2 mm), but comparable sagittal alignment.

**Predicting C5 palsy using preoperative anatomic measurements**

Lubelski et al. evaluated whether the incidence of C5 root palsies could be predicted utilizing preoperative anterior posterior canal diameters (APD), foraminal diameters (FD), and/or cord-lamina angles (CLA) [Tables 1 and 2].

They correlated these parameters with the 12% frequency of C5 palsies seen in 98 CSM patients undergoing anterior or posterior decompressive procedures involving the C4-C5 level. They found “For every 1-mm increase in APD and FD, the odds of developing palsy decreased 69% (P < 0.0001) and decrease 98% (P < 0.0003), respectively.” In contrast, for every 1-degree increase in CLA, the odds of developing palsy increased by 43% (P < 0.0001). The authors concluded they could use these measures to help predict the onset of postoperative C5 palsy.

**Detection and prevention of C5 nerve root palsies after cervical spine decompressions**

Utilizing the PubMed, Embase, and Medline databases, Guzman et al. found 60 articles that cited C5 palsies occurring after cervical spine surgery [Tables 1 and 2].

They found, however, no clear evidence that intraoperative neural monitoring (IONM) or other measures could accurately predict/detect whether these injuries would occur. Furthermore, the overwhelming recommendation was to treat these deficits conservatively, as “most patients make a full recovery within two years.”

**RISK FACTORS AND SURGICAL MEASURES TO AVOID C5 ROOT PALSY**

**Posterior cervical surgery; incidence/risk factors correlating with C5 palsy**

Gu et al. systematically utilized the PubMed, Embase, Web of Science, and Cochrane CENTRAL databases to evaluate the incidence/risk factors contributing to C5 palsy following posterior cervical decompressive surgery [Tables 1 and 2]. Identifying 25 out of 589 studies, they calculated a 5.8% incidence (95% CI: 4.4–7.2%) of C5 palsies following posterior cervical decompressions. The frequency for “open-door laminoplasty, double-door laminoplasty, and laminectomy were 4.5%, 3.1%, and 11.3%, respectively.” Risk factors contributing to C5 palsies included OPLL, narrower preoperative foramina, lamnectomy, excessive spinal cord drift (SMD), and male gender.

**Efficacy of prophylactic c4-C5 foraminotomy to avoid c5 root injuries following open-door cervical laminoplasty**

Over a 2-year period, Ohashi et al. prospectively determined that C5 root injuries could be minimized by prophylactically performing bilateral C4-C5 foraminotomies during open-door cervical laminoplasties [Tables 1 and 2].

They compared the frequency of C5 deficits for 121 (85.8%) patients undergoing laminoplasties with bilateral foraminotomies (group F) vs. 115 (81.5%) having lamnoplasties without foraminotomies (group NF); C5 palsies, respectively, occurred in 1.7% vs. 7.0%. Furthermore, bilateral foraminotomies did not significantly increase postoperative instability, range of motion, hinge fractures or nonunions, and resulted in comparable outcomes (e.g. VAS, JOA scores).
C5 palsies occur in 6 (3.3%) patients (5 M/1F); 4 (3.2%) of 124 with CSM, and 2 (6.5%) of 31 with OPLL. Notably, none exhibited MEP changes.

C5 palsies in cervical spine surgery despite intraoperative monitoring

Currier reviewed the “etiology, risk factors, prevention, and treatment of C5 palsy” occurring during cervical surgery despite the use of IONM [Table 2]. He noted the 3 of 1000 frequency of major deficits (severe motor weakness involving 2 or more extremities in 12 h of surgery) associated with spinal surgery, but the much higher up to 30% incidence of C5 palsies attributed to cervical surgery; fortunately for latter, 70% recover completely with conservative treatment (e.g., no surgery) over an average of 4–5 postoperative months. Furthermore, no treatment strategy (surgery vs. nonsurgical measures) has to reduce the duration, frequency, or degree of resolution of these C5 root deficits. Although evidence supports the role of IONM in detecting/avoiding major neurological injury, there was such evidence documenting the efficacy of IONM in avoiding C5 palsies.

COST AND QUALITY OF LIFE WITH C5 PALSY AFTER POSTERIOR SURGERY

Incidence, cost, and quality of life with C5 palsy after posterior cervical decompression and fusion

Miller et al. looked at the quality-of-life/costs of C5 palsy following posterior cervical decompression and fusion (PCDF). They performed a 2:1 matched retrospective cohort study at a single tertiary-care institution (2007 and 2012) that included all patients undergoing PCDF [Tables 1 and 2]. They studied self-reported “Euroqol-5 Dimensions quality-of-life survey,” physiological parameters (e.g. deltoid and biceps strength – manual testing), functional costs of hospitalization, and missed workdays. Of 245 patients having PCDF, 17 had C5 palsies (6.9%). Of interest, the costs of physical/occupational therapy for the C5 group was significantly higher (average of $2078) as were their overall costs ($1918 higher) vs. those without C5 palsies. Nevertheless, when matched with 34 controls, there were no significant differences in demographic/operative characteristics, cost of hospital stay, surgery, or other direct/indirect costs.

CONCLUSION

The frequency of C5 palsies reportedly varies from 0% to 30%, with many focusing on a risk of 3.1–12%. The presence of preoperative MR-documented HIZ: C3-C5 in the cord opposite the C4-C5 level, surgery (e.g. either anterior or posterior) at the C4-C5 level, and dorsal cord migration all constitute significant risk factors for developing postoperative C5 palsies. Although this review discusses the frequency of C5 root palsies, there appears to be no clear-cut method for avoiding these injuries. Fortunately, the majorities resolve within 3–24 postoperative months without conservative treatment alone.

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