

# Outcome and Incidence of Spinal Instability Following Laminectomy for Cervical Spondylotic Myelopathy

Mohamed R Nagy, MD.

Neurosurgery Department, Faculty of Medicine, Cairo University, Cairo, Egypt.

## Abstract

**Background Data:** Laminectomy for cervical spondylotic myelopathy with no signs of instability is a standard surgical option but it may be associated with post-laminectomy kyphosis.

**Study Design:** Retrospective clinical case study.

**Purpose:** To evaluate the clinical outcome in a series of patients who underwent laminectomy for cervical myelopathy with special stress on the incidence of postoperative spinal instability.

**Patients and Methods:** This study included twenty two patients who underwent laminectomy at a single or more levels, without fusion, for cervical spondylotic myelopathy. The clinical assessment included history taking, neurological examination and postoperative clinical outcome. The radiological assessment included magnetic resonance imaging, computed tomography, and plain antero-posterior, lateral, and lateral flexion-extension X-rays of the cervical spine. The postoperative clinical outcome was assessed in comparison with the preoperative condition as: improved, stable or worsened.

**Results:** Improvement of gait disturbance occurred in 69% of the concerned patients. Sensory deficits and radicular pain improved in the upper limbs (UL) and lower limbs (LL) in 73% and 50%, respectively. Motor deficits improved in the UL and LL in 69% and 55% of the patients, respectively. Postoperative clinical deterioration occurred in two patients (9.1%) and one patient (4.5%) developed postoperative kyphosis.

**Conclusion:** Laminectomy usually results in improvement of the neurological deficits and radicular pain in patients with cervical spondylotic myelopathy with low incidence of postoperative clinical deterioration and instability. (2015ESJ081)

**Keywords:** Laminectomy, Cervical myelopathy, Instability

## Introduction

Spondylosis is the most common cause of neural dysfunction in the cervical spine and is becoming more prevalent as the average life-expectancy increases.<sup>25</sup> The incidence of cervical spondylotic myelopathy (CSM) could be as high as 23%.<sup>15,21</sup> It is a progressively deteriorating process as the spondylotic changes and the cervical deformity compress the cervical spinal cord and roots to present symptomatically as myelopathy or radiculopathy.<sup>6,23</sup> The patients usually present with gait disturbance, paresthesia, radicular pain, weakness or stiffness of the legs and neck pain.<sup>5</sup> The symptoms may be present all together or separately.<sup>8</sup>

Despite conservative management is usually successful in treating CSM, surgical intervention is reserved for patients who have progressive neurological deficits or intractable pain aiming at decompression of the spinal cord and nerve roots and prevention of deformity by maintaining spinal stability and alleviating the pain.<sup>6</sup> Many attempts to determine the optimal surgical approach for patients with CSM have been done. Galbraith et al,<sup>9</sup> reviewed the different surgical techniques for the treatment of CSM, such as posterior decompression through laminectomy with or without fusion or laminoplasty, anterior decompression with or without fusion, or corpectomy. There is still controversy which is the best surgical option.

Laminectomy has been proven to be a safe and effective technique for multilevel decompression for CSM.<sup>8</sup> Laminectomy without fusion has demonstrated comparable immediate postoperative results to laminoplasty and anterior procedures.<sup>4</sup> However, post-laminectomy kyphosis and segmental instability are well-documented complications which are reported to occur in 6–47% of the patients.<sup>14</sup>

The aim of this study was to evaluate the clinical outcome following laminectomy without fusion in a consecutive series of patients presented with CSM without preoperative signs of instability with special stress on the incidence of postoperative instability.

## Patients and Methods

A retrospective analysis on twenty two patients who underwent cervical laminectomy, without fusion as a primary surgery, for cervical spondylotic myelopathy in Neurosurgery Department, Faculty

of Medicine, Cairo University from September 2012 to September 2014 was done. Inclusion criteria involved cervical stenosis and compression of the spinal cord documented by magnetic resonance imaging (MRI) as a result of degenerative changes of the cervical spine. Exclusion criteria included patients with CSM secondary to trauma, neoplasm or Chiari malformation.

All patients went through history taking, neurological examination. Neurological deficits were documented for upper limbs (UL) and lower limbs (LL) including motor deficits, sensory loss, gait disturbance, hyperreflexia and radiculopathy. The radiological assessment included pre- and post-operative MRI, computed tomography (CT), and plain antero-posterior, lateral, and lateral flexion-extension X-rays views of the cervical spine. Radiographic criteria of cervical instability included sagittal plane translation >3.5 mm or sagittal plane angulation >11° in relation to an adjacent vertebra. The Cobb method was used to quantify curvature in the sagittal planes. It described the angle between the superior and inferior limits of the laminectomy levels.

Fiber-optic intubation was used whenever possible to minimize cervical spine movements especially if the patient had a difficult airway or poorly tolerated extension. A neurological examination involving the motor function of all four extremities was documented prior to anesthesia when fiber-optic intubation was used. Hypotensive anesthesia was avoided in order to maintain spinal cord perfusion. The systolic blood pressure was kept above 100 mmHg.

The patients were operated in the prone position with special care to protect the eyes from pressure. The neck was placed into a slightly flexed posture in order to decrease the inter-laminar overlap. The operating table was placed into reverse Trendelenburg position to decrease venous pooling at the surgical site.

The approach to the spinous process was through the midline raphe to limit muscle bleeding and perioperative neck pain. As the dissection proceeded laterally, a strict sub-periosteal plane was maintained with preservation of the nuchal attachments onto the C2 spinous process as much as possible. During the laminectomy, every attempt was done to preserve the facet joints. No instrumentation in the

primary surgery was performed in this series.

During the follow-up period, the patients were assessed clinically and radiologically. The postoperative clinical outcome was assessed in comparison with the preoperative condition as: improved, stable or worsened. The perioperative use of stiff neck collar, additional cervical spine surgery at a later date, and postoperative complications were documented. The follow-up assessment was scheduled at 3 months, 6 months and then annually.

## Results

Twenty two patients underwent cervical laminectomy for CSM from September 2012 to September 2014. The male to female ratio was 2.1:1 and the mean age of the patients was 56 years (Range=49-67 years).

The most common symptom on presentation was gait disturbance which was encountered in sixteen patients (72.2%). The mean duration from the onset of symptoms until the time of surgery was 10 months (range from 6 months to 2 years). The radiological assessment showed that no signs of instability were present before surgery in the patients included in this series.

The levels of cervical laminectomy are presented in (Figure 1). Three or more levels laminectomy was done in 18 patients (81.8%). The average follow-up

time was 15 months (Range=4-mos-3 yrs).

Improvement of gait disturbance occurred in 68.8% of the concerned patients. The sensory deficits and radicular pain improved in the UL and LL in 73% and 50% of the patients, respectively. The motor deficits improved in the UL and LL in 69.2% and 54.5% of the patients, respectively. (Table 1 & Figures 2&3)

The mean preoperative Cobb angle was 13.9° (Range=4°-20°) while the mean postoperative Cobb angle was 18.6° (Range=11°-41°). Table 2 summarized the data of the twenty two patients included in this study. (Table 2)

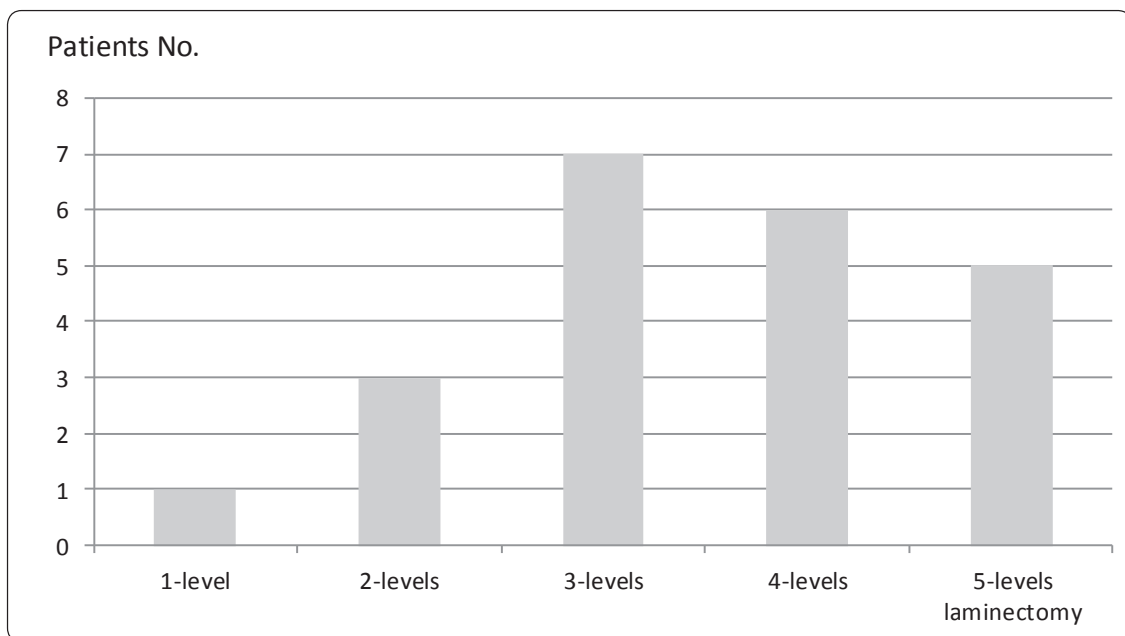
One patient (4.5%) developed postoperative kyphosis as a sign of loss of sagittal balance. This patient was managed by anterior and posterior fixation with realignment of the spine to a certain degree with improvement of his clinical condition postoperatively. Two patients (9.1%) underwent extension of the laminectomy levels without instrumentation due to worsening of the clinical symptoms and neurological deficits. One patient (4.5%) had anterior cervical discectomy with fusion (ACDF) and this was a part of the initial treatment plan to adequately decompress the cervical cord. Wound infection occurred in one patient (4.5%) that needed wound debridement that resulted in good wound healing. There was no perioperative mortality in this series.

**Table 1.** Clinical Findings and Outcome of our 22 Patients.

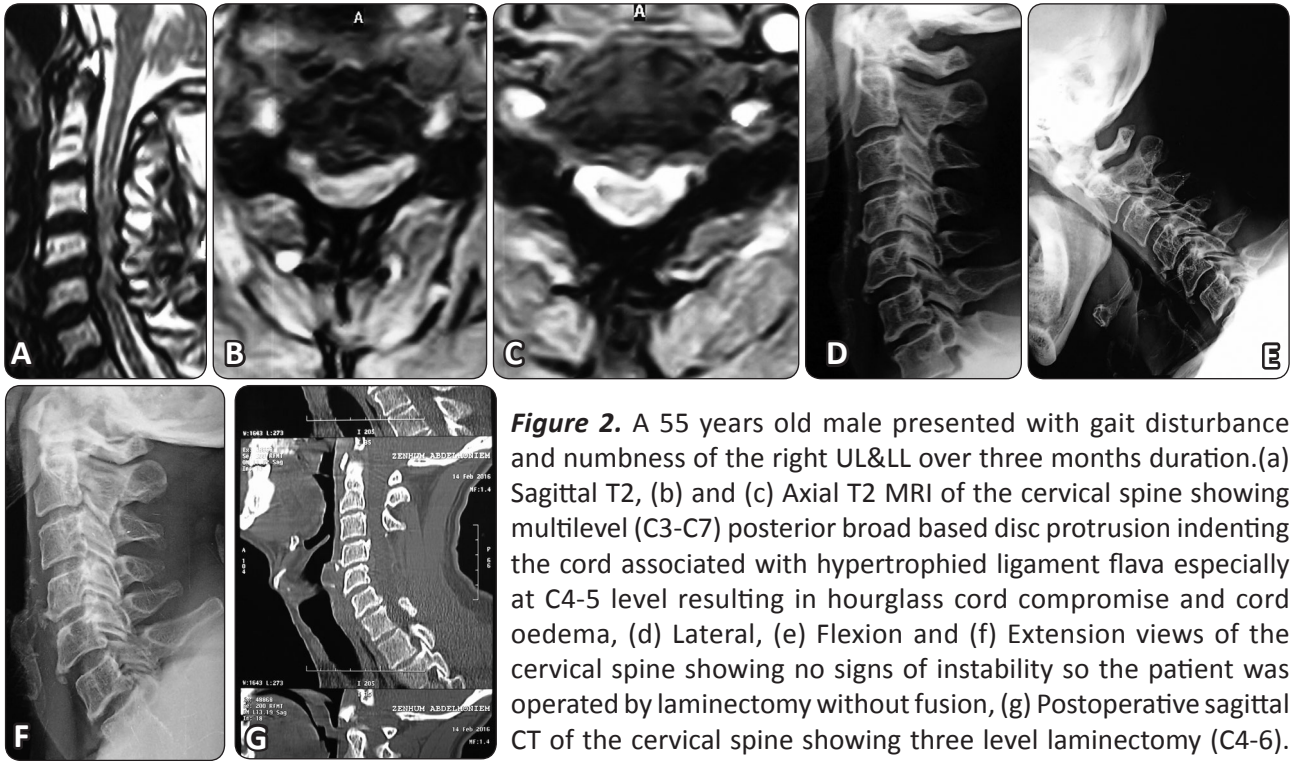
Clinical findings	Limb affected	No. of patients	Improved	Stable	Worsened
Gait disturbance		16 (72.7%)	11 (68.8%)	4 (25%)	1 (6.2%)
Sensory deficits	UL	15 (68.2%)	11 (73.3%)	3 (20%)	1 (6.7%)
	LL	10 (45.5%)	5 (50%)	4 (40%)	1 (10%)
Radicular pain	UL	11 (50%)	8 (72.7%)	2 (18.2%)	1 (9.1%)
	LL	6 (27.3%)	3 (50%)	3 (50%)	0 (0%)
Motor deficits	UL	13 (59.1%)	9 (69.2%)	3 (23.1%)	1 (7.7%)
	LL	11 (50%)	6 (54.5%)	3 (27.3%)	2 (18.2%)
Hyperreflexia	UL	10 (45.5%)	3 (30%)	6 (60%)	1 (10%)
	LL	12 (54.5%)	5 (41.7%)	5 (41.7%)	2 (16.6%)

**Table 2.** Data Summary of our 22 Patients.

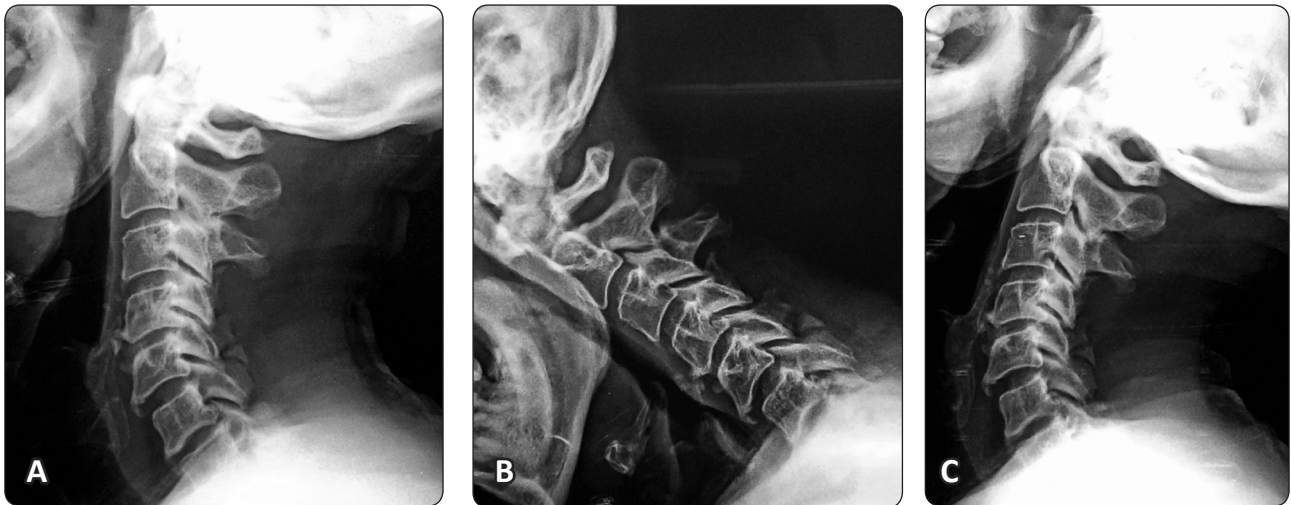
No	Sex	Age/ yrs	Symptom duration	levels	PreOp angle	PostOp angle	Follow up/mos
1	M	52	11	4	17°	19 °	8
2	M	59	18	3	12°	13 °	14
3	M	54	1	4	17°	17 °	12
4	M	61	15	5	16°	21 °	18
5	F	53	7	5	14°	17 °	4
6	M	53	10	2	18°	24 °	10
7	F	51	14	3	12°	26 °	18
8	M	62	8	4	20°	20 °	7
9	M	49	4	3	13°	13 °	5
10	M	55	3	3	15°	17 °	24
11	F	57	12	5	14°	17 °	16
12	M	56	9	3	13°	14 °	1y
13	M	52	6	1	18°	18 °	15
14	F	63	14	5	14°	14 °	36
15	M	59	5	2	17°	26 °	12
16	M	53	24	3	16°	23 °	10
17	F	55	9	4	10°	18 °	24
18	F	58	18	5	4°	41 °	18
19	M	67	4	3	8°	11 °	18
20	M	50	14	2	11°	11 °	13
21	F	60	6	4	13°	16 °	12
22	M	53	8	4	14°	14 °	24



**Figure 1.** Incidence and number of decompressed cervical levels.



**Figure 2.** A 55 years old male presented with gait disturbance and numbness of the right UL&LL over three months duration. (a) Sagittal T2, (b) and (c) Axial T2 MRI of the cervical spine showing multilevel (C3-C7) posterior broad based disc protrusion indenting the cord associated with hypertrophied ligament flava especially at C4-5 level resulting in hourglass cord compromise and cord oedema, (d) Lateral, (e) Flexion and (f) Extension views of the cervical spine showing no signs of instability so the patient was operated by laminectomy without fusion, (g) Postoperative sagittal CT of the cervical spine showing three level laminectomy (C4-6).



**Figure 3.** At 18 months follow up of the patient. (a) Lateral, (b) Flexion and (c) Extension views of the cervical spine showing still maintained cervical lordosis without signs of postoperative instability.

## Discussion

Cervical spondylotic myelopathy is a common disorder which can lead to significant clinical morbidity. There are many surgical techniques to address this disorder, including anterior, posterior or circumferential approaches.<sup>9</sup> There is still controversy about the best treatment option for patients with CSM. Mummaneni et al,<sup>16</sup> reviewed

data published between 1966 and 2007 to create an evidence-based approach considering the options and their efficacy in the surgical treatment of CSM. The authors concluded that laminectomy and anterior approaches such as anterior cervical decompression with fusion (ACDF) and anterior cervical corpectomy with fusion (ACCF) were equal surgical treatment options for CSM.

It is important to tailor the surgical plan



according to each individual's unique clinical circumstances. Designing the most effective surgical plan is dependent on many factors including the location of the compressive pathology, stability of the spinal column, extent of the disease, the patients' age, medical comorbidity and the surgeon's experience. Hasegawa et al,<sup>11</sup> found that the age does not affect the surgical outcome of patients with CSM, but can influence the risk of perioperative complications. The pre-operative radiological assessment (which showed no signs of instability of the cervical spine) rather than consideration of age led to the decision for laminectomy without fusion in this study. Regarding the pathophysiology of cervical stenosis, it was found that patients with absolute stenosis (<10 mm canal diameter) develop symptoms in their 40s and 50s<sup>7</sup>, while patients with relative stenosis (10-13 mm canal diameter) will present with radiculopathy and CSM in their 50s and 60s.<sup>23</sup>

When considering the surgical outcomes for CSM, it was found that regardless of the surgical technique employed, the results of surgery are generally better in patients who undergo early decompression. In this study, the mean duration from the onset of symptoms until the time of surgery was 10 months. In a prospective study of 146 patients with cervical spondylotic myelopathy, Suri et al,<sup>22</sup> noted that patients with less than a one year duration of symptoms showed significantly greater motor recovery following operation than did those with a longer duration of symptoms.

In this study, laminectomy without fusion for treatment of CSM resulted in improvement of the neurological deficits and the radicular pain in more than 60% of the patients. This outcome was in accordance with reported results after posterior decompression for CSM. Arnold et al,<sup>2</sup> reported that of 44 patients treated with laminectomy, 77% show early improvement (within six months) and 52% show late improvement (mean: eight years). Bapat et al,<sup>3</sup> observed in a study with 129 patients, undergoing either anterior or posterior decompression, that 73% of the patients treated by laminectomy show an improvement. Other reports<sup>1,19</sup> suggest a good outcome with recovery rates between 42% and 92%. In this study, worsening of the neurological deficits occurred in two patients (9.1%). This rate is similar to other studies reporting complication or failure

rates from 6% to 38%.<sup>12</sup>

A posterior approach is best utilized when pathology is present dorsally in the spinal canal. It avoids extensive dissection of vital neck structures and graft-related complications encountered with anterior approaches.<sup>7,20</sup> Bapat et al,<sup>3</sup> concluded that for multilevel CSM the clinical outcome after anterior or posterior surgery is comparable with the complication rate being higher after anterior surgery and patients who undergo laminoplasty experience more continuous axial pain. However, when surgery is performed on patients with additional disc herniation, spurs or ossification of the posterior longitudinal ligament, ACDF or ACCF reduces further neurological deterioration and progression of spinal deformities. In this study, one patient underwent additional anterior decompression, but this was part of the surgical plan designed to achieve adequate spinal cord decompression.

Despite laminectomy in carefully selected patients is a good choice of treatment for patients with multilevel CSM, it has been associated with delayed onset of clinical deterioration and spinal instability. However, the development of kyphosis did not appear to correlate with the observed delayed neurological deterioration.<sup>13,17</sup> Factors that correlated with greater susceptibility to deterioration include advanced age (>70 years at the time of the first surgery), severe original myelopathy and recent trauma.<sup>8</sup> Other complications of the posterior approach include postoperative pain from injury to para-spinal muscles and epidural hematoma. It is contraindicated in a kyphotic deformity. In this series, one patient (4.5%) developed instability of the cervical spine, whereas in a series of 58 patients undergoing multilevel laminectomy for CSM, reported by Guigui et al,<sup>10</sup> 15% of the patients develop a destabilization of the spine postoperatively. In that report three patients underwent reoperation. The low incidence of postoperative instability in this study in comparison with other studies may need greater number of patients and longer follow-up period to be confirmed. However, in Woernle et al,<sup>24</sup> reported series of 65 patients who underwent posterior decompression for CSM, only one patient (1.5%) developed postoperative kyphosis.

Laminectomy can be augmented to include posterior instrumentation to address instability which leads to lower rates of kyphosis and

segmental instability. Perez-Lopez et al,<sup>18</sup> compared 19 patients that underwent laminectomy to 17 that underwent laminectomy and fusion. They found similar improvement in both groups but there was an increase in postoperative kyphosis within the laminectomy alone cohort (24%) compared to the laminectomy and fusion group (7%). Despite this increased stability, addition of instrumentation can lead to complications such as hardware failure with loss of alignment and neurological damage from misplaced lateral mass screws. Adjacent segment degeneration can also occur due to alterations to cervical biomechanics and force distribution following a fusion procedure.<sup>13</sup>

Due to the retrospective nature of this study, scores such as the modified Japanese Orthopedic Association Myelopathy (mJOA) score or the Nurick scale were not applied and pain scores such as Visual Analog Pain Scale were not constantly assessed. However, individual pre- and postoperative clinical parameters were assessed in each patient.

## Conclusion

Cervical laminectomy is a safe and effective surgical option in carefully selected patients with multilevel CSM. It usually results in improvement of the neurological deficits and the radicular pain in these patients with a reasonably low incidence of postoperative clinical deterioration and cervical instability.

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Address reprint  
request to:

**Mohamed R Nagy, MD**

Department of Neurosurgery, Faculty of Medicine, Cairo University, Cairo, Egypt  
E-mail: dr\_mohamedragab@hotmail.com

## الملخص العربي

### الناتج ومعدل حدوث عدم ثبات الفقرات بعد استئصال الصفائح الفقارية لخشونة الفقرات العنقية المؤثرة علي النخاع الشوكي

**البيانات الخلفية:** استئصال الصفائح الفقارية لخشونة الفقرات العنقية المؤثرة علي النخاع الشوكي هو اختيار جراحي معروف ولكنه قد يكون مصحوبا باعوجاج العمود الفقري بعد العملية.

**تصميم الدراسة:** دراسة حالات إكلينيكية بطريقة الاستعادة.

**الهدف:** تقييم الناتج الإكلينيكي لاستئصال الصفائح الفقارية لخشونة الفقرات العنقية المؤثرة علي النخاع الشوكي مع التركيز علي معدل حدوث عدم ثبات الفقرات بعد الجراحة.

**المرضى والطرق:** اشتملت الدراسة علي اثنين وعشرين مريض أجريت لهم جراحة لاستئصال الصفائح الفقارية بدون تثبيت علي مستوى واحد أو أكثر لخشونة الفقرات العنقية المؤثرة علي النخاع الشوكي. شمل التقييم الإكلينيكي اخذ التاريخ المرضي والفحص العصبي للمرضي وشمل التقييم عمل الرنين المغناطيسي و الأشعة المقطعية والاشعات الاكس علي الفقرات العنقية. تم تقييم حالة المرضي بعد الجراحة إذا كانت تحسنت أو ثابتة أو ساءت.

**النتائج:** تحسنت اضطرابات المشي في ٦٩٪ من المرضي وتحسنت العوارض العصبية الحسية والآلام الطرفية في الأطراف العلوية والسفلية في ٧٣٪ و ٥٠٪ من المرضي علي الترتيب فيما تحسنت العوارض العصبية الحركية في الأطراف العلوية والسفلية في ٦٩٪ و ٥٥٪ من المرضي علي الترتيب. تدهورت حالة مريضين بعد الجراحة فيما عاني مريض من اعوجاج العمود الفقري بعد الجراحة.

**الاستنتاج:** استئصال الصفائح الفقارية لمرضي خشونة الفقرات العنقية المؤثرة علي النخاع الشوكي يحسن عادة العوارض العصبية والآلام الطرفية للمرضي مع معدل منخفض لعدم ثبات الفقرات بعد الجراحة.