The purpose of this study was to determine the average age of individuals diagnosed with cervical spinal myelopathy who are known cocaine users vs nonusers, as well as the postoperative change in neurological condition between cocaine users and nonusers. Medical records of patients diagnosed with cervical spinal myelopathy between January 1990 and May 2006 were reviewed. Ninety-four patients were identified who underwent any surgical intervention with at least 2 years of follow-up. Group 1 comprised patients with cervical spinal myelopathy who had used cocaine, and group 2 comprised patients with cervical spinal myelopathy who had not used cocaine. All patients were clinically evaluated by the Nurick grade preoperatively and at most recent follow-up. Mean follow-up was 25 months. Mean age at presentation was 52 years (range, 44-62 years) in group 1 and 56 years (range, 42-88 years) in group 2. Average duration of symptoms prior to surgical intervention was 18.6 months in group 1 and 10 months in group 2. Average Nurick grade at presentation was 2.7 for group 1 and 2.7 for group 2. Average postoperative Nurick grade was 1.9 for group 1 and 1.33 for group 2. Change in Nurick grade was 0.8 for group 1 and 1.11 for group 2. Linear regression analysis comparing change in Nurick grade (from pre- to postoperative) was conducted, showing a correlation of $-0.45$ with a $P$ value of .044.

To the authors’ knowledge, this is the first study demonstrating that cocaine use has an effect on postoperative improvement of neurological function in cervical spondylotic myelopathy.
Cocaine is a powerfuly addictive stimulant that directly affects the central nervous system. Cocaine was labeled the drug of the 1980s and 1990s because of its extensive popularity and use during this period. In 2010, an estimated 1.5 million people aged 12 or older, or 0.6% of the population, were cocaine users. These numbers have fallen since 2006, when a reported 2.4 million people, or 1% of the population, were users. Of 2.4 million cocaine users, an estimated 2.0 million people are current (past-month) users.1

Studies regarding the neurovascular complications of cocaine report that cocaine use exacerbates and accelerates the natural history of neurological pathology, regardless of the route of administration.2,3 Central nervous system infarction has been strongly linked to cocaine abuse.3-7 Infarction can occur in many anatomical regions, including the middle cerebral artery and vertebrobasilar artery territories, anterior spinal artery, and lateral medulla.8

Chronic sequelae of cocaine use have been less well studied. Some studies have reported that chronic use can lead to moderate and persistent alterations in cerebral and spinal blood flow.9 Another study reported an increased incidence of cerebral vasculitis among cocaine users.10 However, a record of the effect of cocaine on symptomatic spinal disease has not been documented.

Cervical spondylotic myelopathy comprises a spectrum of symptoms caused by compression of the cervical spinal cord. Typical findings include leg spasticity, upper-extremity weakness or clumsiness, and sensory changes in the trunk or extremities. Some patients exhibit leg or trunk numbness with leg flexion (Lhermitte’s sign). Loss of sphincter function can follow as the disease progresses. In spinal canals that are congenitally small, any spinal column pathology can produce impingement on the spinal cord. Some patients have a stable neurologic deficit, whereas others progress insidiously.11 Treatment ranges from conservative, including bed rest, to operative, including surgical decompression, but outcomes are strongly affected by the preoperative condition of the patient’s spinal cord.12

The first purpose of this study was to determine the age at which diagnosis of cervical spondylotic myelopathy was made in cocaine users vs noncocaine users, and the second purpose was to determine whether previous cocaine use or abuse affects neurological improvement following surgery to correct cervical spondylotic myelopathy.

**MATERIALS AND METHODS**

Institutional review board approval was obtained from the clinical research department. The authors retrospectively reviewed the medical records of patients diagnosed with cervical spondylotic myelopathy who underwent surgical intervention at the home institution (University Hospitals of Cleveland, Cleveland, Ohio) and the associated veterans’ medical center. All surgeries were performed by the senior author (N.U.A.) between January 1990 and March 2007. Cervical spondylotic myelopathy was initially diagnosed if abnormal reflexes, such as clonus, positive Babinski’s sign, or positive Hoffman’s sign, were evident on physical examination or if the patient had demonstrable disturbance of gait or difficulty with fine motor movements (eg, clumsiness of the upper extremities or hyperactive reflexes). Inclusion criteria for the study were diagnosis of cervical spondylotic myelopathy with Nurick grade followed by surgical treatment and at least 2 years of follow-up.

Group 1 comprised patients with cervical spinal myelopathy who used cocaine \((n=11)\), and group 2 comprised patients with cervical spinal myelopathy who had not used cocaine \((n=83)\). All patients were clinically evaluated by Nurick grade preoperatively and at most recent follow-up.13 Age at presentation, pre- and postoperative Nurick grade, and preoperative duration of symptoms were recorded. Mean follow-up was 25 months.

**SURGICAL TECHNIQUE**

The patients were selected for 1 of 4 procedures (Table): single- or double-level corpectomy,14 anterior cervical decompression with strut grafting and instrumentation,15 posterior cervical laminoplasty, or posterior cervical laminectomy and fusion.16 All patients were put in a Miami J collar (Össur, Foothill Ranch, California) postoperatively.

All surgeries were performed at the university hospital and the veterans’ medical center with the assistance of spine fellows and residents. Data were recorded from hospital and electronic records, including age at presentation, pre- and postoperative Nurick grade, change in Nurick grade (pre- to postoperative), and preoperative duration of symptoms. Postoperative evaluation occurred at 6 weeks, 3 and 6 months, and 1 year postoperatively, and annually thereafter.

**Table**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Group 1</th>
<th>Group 2</th>
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<tbody>
<tr>
<td>Single- or double-level corpectomy</td>
<td>5</td>
<td>53</td>
</tr>
<tr>
<td>Anterior decompression and strut grafting with instrumentation</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Posterior cervical laminoplasty</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Posterior cervical laminectomy and fusion</td>
<td>2</td>
<td>4</td>
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</tbody>
</table>

**Distribution of Patients Among 4 Procedures**

**References**

The senior author, spine fellows, and residents evaluated patients in the clinic. A complete neurologic examination was conducted, and a Nurick grade was calculated at every visit. Nurick grades for severe myelopathy are as follows: grade 0, signs or symptoms of root development but without spinal cord involvement; grade 1, signs of spinal cord disease but no difficulty in walking; grade 2, slight difficulty in walking that does not prevent full-time employment; grade 3, difficulty in walking that prevents full-time employment or the ability to do all housework; grade 4, able to walk only with someone else’s help or with the aid of a frame; grade 5, chair bound or bedridden. Patients were also sent to physical and occupational therapy.

RESULTS
The first objective of this investigation was to determine the age at which diagnosis of cervical spondylotic myelopathy was made in cocaine users vs noncocaine users. Ninety-four patients (73 men and 21 women) with at least 2 years of follow-up were identified who underwent surgical intervention for cervical spondylotic myelopathy. Group 1 comprised 31 cigarette smokers, and group 2 comprised 11 cigarette smokers (the entire group). Average age at presentation for group 1 was 52 years, with a duration of symptoms of 18.6 months. Average age at presentation for group 2 was 58 years, with a duration of symptoms of 10 months.

The second objective of the investigation was to discern a difference in outcomes after surgery to alleviate cervical spondylotic myelopathy. Group 1 had an average Nurick grade of 2.7 preoperatively and 1.9 postoperatively, with a change in Nurick grade of 0.8. Group 2 had an average Nurick grade of 2.6 preoperatively and 1.11 postoperatively, with a change in Nurick grade of 1.33.

Linear regression analysis was used to compare the change in Nurick grade and cocaine use to discern whether a significant correlation existed between cocaine use and postoperative improvement in patients with cervical spondylotic myelopathy. Before correcting for age, sex, smoking, and time to surgery, the correlation coefficient was \( -0.64 \) (\( P = .002 \)). After correcting for these potential confounders, the coefficient was \( -0.45 \) (\( P = .044 \)).

DISCUSSION
Cocaine’s effect on the central nervous system has been well documented in the literature: the compound prevents the uptake of sympathomimetic neurotransmitters by nerve terminals, which may result in sensitization to epinephrine and norepinephrine and produce vasoconstriction of the blood vessels, including the anterior spinal artery; enhance the response of platelets to arachidonic acid, leading to the increased production of thromboxane and platelet aggregation; and contribute to another mechanism of infarction to the central nervous system, including the spinal cord.\(^5\) It has also been suggested that chronic cocaine use leads to moderate and persistent alterations in cerebral and spinal blood flow.\(^6\) The ability of the spinal cord to heal after surgical decompression in a patient with cervical spondylotic myelopathy secondary to severe stenosis is based on the intrinsic ability of the spinal cord to heal itself. Thus, the preoperative health of the cord is paramount to postoperative improvement.\(^14,17\)

This study was limited by its retrospective design. All patients investigated were evaluated and treated at 2 institutions and attended by 1 surgeon; examinations or surgeries may have differed from those of other institutions. However, the consistency of evaluation and treatment may have aided the reliability of the data. Also, during evaluation and treatment, the evaluating physicians were not blinded to the patients’ cocaine use; however, the authors do not believe that this altered the surgery methods or significantly affected the patients’ evaluations. Finally, the frequency of cocaine use and the last use of cocaine was not known from the data collected. Therefore, it may not be possible to generalize the results to 1 type of cocaine user but rather cocaine use in general. It is possible that confounding comorbidities associated with cocaine use may have led to worse functional outcomes regardless of spinal surgery; for instance, it is possible that patients with vascular disease of the spine may have had concurrent vascular disease of higher-order neurons in the brainstem, cerebral cortex, or cerebellum.\(^18\) However, careful documentation of myelopathic findings on magnetic resonance imaging for the study patients showed that cervical spondylotic myelopathy contributed to symptoms regardless of comorbidity.

To the authors’ knowledge, no other study has evaluated the surgical outcome of decompression for cervical spondylotic myelopathy in cocaine users.

CONCLUSION
Cocaine has a negative effect on the spinal cord’s intrinsic ability to heal after surgical decompression due to its numerous neuropathologic effects in the central nervous system, including its ability to cause vasoconstriction and vasculitis of anterior spinal artery, which may lead to injury to the cord that is not evident on magnetic resonance imaging.

REFERENCES


