Diseases of the spine have become more common because of the aging population. Degeneration of the disks and vertebral bodies is a common finding; MRI detected cervical lesions affect the spinal cord in 26 percent of asymptomatic older patients. Cervical degeneration may lead to cervical stenosis, which can cause progressive neurologic impairment. Some patients remain static in their symptoms while others develop progressive disability requiring surgery. Even with surgery, results are unpredictable and neurologic disability continues. This article reviews the current trends in the diagnosis and treatment of cervical myelopathy as well as the classification of disability in patients who have treatment.

CASE STUDY
A 62-year-old female presented with the chief complaint of right upper extremity weakness and pain. The weakness began six months prior to presentation and was initially localized to the right arm. There was no history of trauma or lifting. She first noted weakness with opening a jar and then it progressed to difficulty with writing. The weakness was progressive and then was accompanied by numbness and tingling of the right hand. Four weeks prior to presentation the patient began to experience neck pain with radiation to the right arm and hand. There were no bowel or bladder changes. Her medical illnesses included diabetes, asthma and hypertension. Physical examination demonstrated a well-developed 62-year-old female who was in mild distress due to right-sided neck pain and arm pain. Movements of her neck were limited in flexion and extension. Pain radiated to the right shoulder and arm with extension movements of the neck. Her right bicep, wrist extensors and finger extensors were rated at -4/5. Her grip was weak on the right side. Her finger flexors and abductors were rated 4/5. Sensation was diminished along the radial side of the forearm and thumb. Hoffman’s sign was absent. An MRI scan of the cervical spine (Fig. 1) demonstrated stenosis of the cervical spine at the C5-6 level due to a combination of disc herniation anteriorly and boney impingement posterior combining to narrow the canal. The axial view demonstrates flattening of the cervical cord. On review of these findings as well as the physical examination the patient was advised on anterior surgery. She underwent a C-6 corpectomy with discectomy at the C5-6 and C6-7 levels with cage and plate fixation to stabilize the spine (Fig. 2). The patient’s weakness improved post-operatively and her pain resolved.

DISCUSSION
Many patients and providers think that neck pain is a “normal” part of aging, but practitioner vigilance is key for identifying myelopathy and differentiating it from other causes of neck pain, including arthritis. The inclusion of the term “spondylotic” into “cervical spondylotic” myelopathy reflects the fact that myelopathy, or dysfunction of the spinal cord, is often times associated with and caused by the normal osteoarthritic changes of the axial spine that accompany normal aging. This myelopathy can be divided into five related syndromes based on the location of the pathology within the cervical spine (lat-
eral, medial, combined, vascular and anterior). All five types share either clinical symptoms or signs and radiographic evidence of compression of the spinal cord.

The first, lateral cervical myelopathy, is characterized by predominantly nerve root symptoms (e.g. radicular pain or unilateral neurological deficits). The second, medial cervical myelopathy, is characterized by long tract symptoms and frequently spares the upper limbs as these nerve fibers are usually located further from the midline. Most commonly however, the clinical picture has elements of both lateral and medial types and is referred to as combined cervical myelopathy (the third type). A fourth syndrome, vascular cervical radiculopathy, may not show any clear pattern and is thought to result from spinal cord ischemia. This type is least common. The anterior syndrome, consisting of painless weakness in the upper extremities without accompanying symptoms of the lower extremities, is the fifth type of cervical myelopathy.

The clinical presentation of patients with cervical spondylosis with stenosis and spinal cord compression can be varied. Patients can have profound degrees of spinal cord compression on the MRI with minimal or no symptoms, while others become profoundly symptomatic with far lower degrees of pathology. Paresthesias are common, usually in a global non-dematomal pattern in both upper extremities. Subtle changes in gait and balance often precede clinically obvious weakness. As the condition progresses, patients will note impairments in fine motor control. Manipulation of writing instruments and struggling with aspects of self-care (grooming, dental care, dressing, etc.) become apparent. Patients with cervical myelopathy usually have greater compromise of the proximal motor groups of the legs, whereas those with lumbar stenosis suffer more from weakness of more distal muscle groups. Most patients will present with moderate to severe neck pain; approximately 15 percent of patients lack painful symptoms.

A thorough history will lead the physician to suspect the diagnosis. Questions regarding onset of symptoms are very important because the condition develops slowly. It may be an interval of years before the patient seeks medical help. Early symptoms may include lack of balance and disturbance of gait. "Electrical shock" sensations in the arms and legs can occur when the neck is flexed or extended. Weakness in the hands and writing disturbances are late findings. Bowel and bladder dysfunction may not be a common complaint but must be approached in the patient’s history.

On physical examination, patients usually have evidence of upper and lower motor neuron deficits. Subtle loss of fine movement in the fingers and unsteadiness of tandem gait is found. Hyperreflexia and clonus in the lower extremities may be present. The vigilant physician should evaluate the patient for long tract signs including abnormal plantar response and the presence Hoffman’s reflex in the hands. An inverted radial reflex may be present. The Hoffman’s reflex should be described as “present” or “absent” as opposed to “positive” or “negative.” The inverted radial reflex is evaluated by eliciting the brachioradialis reflex and observing the response of the ipsilateral fingers. This reflex is also characterized as present if the brachioradialis reflex is hypoactive and the fingers flex slightly with each tap of the reflex hammer. None of these tests is reliable to make the diagnosis by itself, the sensitivity may be as low as 58 percent.

Tests of hand dexterity are also indicated when looking for possible cervical myelopathy. The grip and release test may be performed. A normal patient should be able to grip and release their hand approximately 25-30 times in 15 seconds. Patients who struggle with this test may also have a loss of motor strength, sensory changes, wasting of the intrinsic muscles and spasticity, a constellation of signs commonly describes as “myelopathy hand.” Sensory and vibratory testing can be performed in addition, and patients with cervical myelopathy will often be hyperreflexic in the upper and lower extremities.

Radiographic evaluation of the patient with suspected cervical myelopathy is appropriate, and begins with the AP and lateral plain x-ray. Findings such as disc space narrowing, facet joint arthrosis, bone spurs, ossification of the posterior longitudinal ligament (OPLL), and kyphotic deformity are all suggestive (but not independently diagnostic) of cervical myelopathy. Flexion/Extension radiographs are also indicated, especially if no significant stenosis is seen on static films, as there may be dynamic stenosis that will only be revealed at the extremes of normal motion. This is especially likely in patients who have decreased mobility over several contiguous levels due to stiff spondylotic changes, as the remaining less stiff affected segments will be forced to compensate with greater mobility (and perhaps, compression of the spinal cord). Additionally, comparison of standing radiographs to those obtained while sitting can often provide important information about the stability and motion of the cervical spine under physiologic load.

MRI is the best modality for evaluation of spinal stenosis and damage to the spinal cord. Narrowing of the spinal canal by bone or soft tissue is best seen on the sagittal and axial images. Disc herniations, ligamentum hypertrophy and facet overgrowth are important findings evident on the MRI. Measurement of the spinal canal can also be accomplished to diagnose congenital narrowing. Low intensity signal changes on the T-1 weighted MRI and high intensity changes on the T-2 weighted MRI are commonly observed in cases of cervical myelopathy. To date, researchers have presumed that these changes could reflect tissue destruction such as myelomalacia or gliosis due to long term spinal cord compression. Currently, high intensity signal changes on T-2 imaging are thought to indicate edema and gliosis (which may both be reversible), while low intensity signal changes on T-1 images are thought to represent myelomalacia and necrosis (usually irreversible).
MANAGEMENT

Treatment of cervical myelopathy should be based on the knowledge of the natural history of the condition. The prognosis for patients with this condition can be variable with some patients’ neurologic condition remaining static for years and other experiencing slow deterioration. Studies by Lees and Turner and Clarke and Robinson described the slow deterioration of neurologic function followed by periods of quiescence. Very rarely was there rapid progression of symptomatology. It has been reported that 75 percent of their patients experienced episodic worsening with neurologic deterioration of their condition. About five percent of their patients had a rapid decline of neurologic function. Barnes and Saunders reported the majority of their patients remained stable for years with more deterioration prevalent in females. With this in mind, patient’s presentation and neurologic examinations should help guide the physician’s recommendation for treatment. A statistically significant correlation has been observed between the surgical presentation and neurologic examinations should help guide the physician’s recommendation for treatment. A statistically significant correlation has been observed between the surgical result and the length of a patient’s clinical history.

Treatment is therefore based on the patient’s presenting symptoms and progression of the condition. Non-surgical management can be effective in some patients with mild symptoms who are not impaired by their condition. Their treatment will center on education about the disease and behavioral methods to prevent injury. A prospective study by Kadanka has demonstrated that patients with mild cervical myelopathy may not progress. Forty-eight patients with mild cervical myelopathy were randomized to operative or non-operative treatment. At year two follow up, the functional improvement for patients receiving surgery was not statistically better than patients receiving non-operative treatment. Patients with mild gait instability can be helped by therapy with an emphasis on fall prevention and balance training. Conservative treatment has been successful in preventing progression in up to 70 percent of patients with the remaining 30 percent requiring surgery.

Patients who have shown deterioration of their condition and poor response to conservative care will fall into the surgical category. It is generally agreed that progressive neurologic deficits with weakness, significant gait instability and bowel and bladder dysfunction require surgery. A frank discussion regarding the risk benefit ratio of surgery with the patient needs to take place. The results of surgery in this population are hard to predict. A short-term prospective multicenter non-randomized comparison of operative and non-operative treatment for cervical myelopathy was reported by Sampath. At a mean follow up of 11 months, patients treated non-operatively have a significant worsening of their ability to perform activities of daily living. A Cochrane Review of randomized controlled trials for the role of surgery in mild cervical myelopathy concluded that the early results of surgery were superior to non-operative treatment in terms of pain, weakness and sensory loss. However, no significant differences were found at one year. Overall the data from reviewed trials was inadequate to define the role of operative treatment in CSM. Patients with larger transverse area of the cord, younger patients and those with a shorter duration of symptoms have a better prognosis with surgery.

Once surgery has been decided upon, the role of the patho-anatomy of cervical spondylosis will guide the surgeon on the type of procedure that is required. The condition begins with the deterioration of the intervertebral disc, which results in a reactive hyperostosis of the vertebral bodies. These spurs may project into the spinal canal and reduce the space available for the spinal cord. A developmentally narrow canal can be more susceptible to cord impingement. Other factors include herniation of the vertebral discs, ossification of the posterior longitudinal ligament, enlargement of the uncovertebral processes and thickened ligamentum flavum.

The surgical procedures for the treatment of cervical myelopathy can be divided into anterior and posterior procedures. The anterior approach is recommended when the myelopathy is caused by anterior compression at one or two levels. This type of procedure removes the offending disc, osteophytes or ossified posterior ligament to decompress the spinal canal from the front. Bone grafting the space between the vertebrae establishes stability to the spine and corrects any malalignment at the time of surgery. Clinical series by Smith and Robinson and Cloward have demonstrated successful arthrodesis in greater than 90 percent of patients. Kadoya et al demonstrated that osteophyte removal could be safely performed in his series of 43 patients with myelopathy who underwent decompression using a microscope. Complications are generally low but the surgeon must be watchful of graft collapse and extrusion. Non-union can occur with multiple levels of fusion (greater than three). Synthetic interbody spacers and the application of plate fixation to the vertebral bodies of the spine have decreased the incidence of graft complications and pseudarthrosis.

Patients who demonstrate primarily dorsal compression of the spinal canal due to ligamentum flavum in folding developmental stenosis and facet hypertrophy are best suited for a posterior procedure. These include either a laminectomy, laminoplasty or for those who demonstrate instability of the spine, a laminectomy and fusion. Overall, good to excellent results have been reported by Kaptain in 40-85 percent of patient after laminectomy. These procedures decompress the spinal canal under direct visualization with removal of the posterior boney architecture including the lamina and ligamentum. The removal of a portion of the facet joint can also be done to open the neural foramen. Laminoplasty is a newer technique that preserves a portion of the posterior lamina in a hinge type of procedure. Reconfiguring the posterior bony arch increases the spinal canal area. Radiographic and anatomic studies, Edwards have demonstrated laminoplasty’s ability to expand the cross-
sectional area of the canal and decompress the spinal cord. This also allows reattachment of the muscles to the spine to allow for preservation of alignment. These posterior procedures are recommended only if the patient has a straight or lordotic spinal alignment preoperatively. The superiority of one procedure over the other has not been established. Post-laminectomy kyphosis must be avoided with this procedure.

Laminectomy and fusion procedures allow the surgeon to approach the spine posteriorly without the worry of developing postoperative instability or kyphosis. Posterior plating of the spine at the time of surgery preserves the lordotic posture of the spine and prevents segmental instability post-operatively, Kumar.19 Fusion also allows a more expansive laminectomy and foraminal decompression. Limitations of the procedure relate to establishing a stable fusion, non-union, hardware failure, adjacent segment degeneration and donor site discomfort.

OUTCOMES

Cervical myelopathy, whether treated conservatively or surgically may result in some degree of impairment. In the medical literature, patients and their conditions are often looked at and assessed in degrees of disability, impairment, and handicap.

When discussion regarding disability is brought up, the context it is used in is often that described by the World Health Organization (WHO). Disability is a limitation in activity or restriction secondary to impairment. Impairment is any loss or abnormality in physiologic or anatomic function. If someone with cervical myelopathy had significant disturbance with balance and gait, that patient’s ambulation would be impaired. In contrast, the term handicap refers to a disadvantage due to the impairment or disability, which prevents that person from completing tasks and/or activities of daily living.4

Outcomes from treatment can vary. If symptoms are stable, and not progressing, a conservative management and treatment program should be considered. In more severe progressive cases, surgical intervention has shown to provide improvement in symptoms.18 In the short term of surgical treatment, and 5-year point of follow up, it was shown that 70 percent of the patients demonstrated “worthwhile improvements” after completing surgery.1 In a longer-term study by Kadanka,15 no significant difference between the progress of the surgical group and conservatively managed groups were noted. The study looked at two groups of patients with cervical myelopathy, and followed them over a 10-year period.15

Several approaches have been documented and used to demonstrate impairment associated with cervical myelopathy, treatment, and progression. The severity of cervical myelopathy has often been looked at with the Japanese Orthopedic Association Scale (JOA) and Nurick Scale.14 Both of these scales assess the function of ambulation, sphincter control, and sensation as related specifically to the patient with cervical myelopa-

The Nurick scale looks at gait and ambulation and grades patient dysfunction with ambulation, and their ability to be employed.22 The JOA is a scale that looks at extremitiy functions, coupled with sensory and bowel/bladder control.13

The JOA has been used as a template for several other scales with slight modification or addition of other components to the examination. These include things like motor function, activities of daily living (ADLS). Furthermore, the Neck Disability Index as well as the Myelopathy Disability Index have been developed to assist with the cervical myelopathy patients assessment of function and progress.1 Recently the Short Form – 36 has been developed; this takes into account both function and improvements in quality of life. However, none of the aforementioned outcome scales assess depression or anxiety associated with the diagnosis or treatment.

In regard to outcomes from both conservative and surgical management, no clear data has proven to demonstrate overwhelming benefits of one over the other. In those cases that have progression of cervical myelopathic symptoms, surgical intervention is crucial. Those who are stable may have the option of either conservative or surgical management. Most of the data and studies in the short term do demonstrate an improvement in function and quality of life. However, beyond the 10-year mark, no clear difference in improvement between the surgically and non-surgically treated patients exists.

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