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Clinical Perspectives on Tandem Spinal Stenosis: Addressing the Controversies in Surgical Management

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ABSTRACT

Introduction: Tandem spinal stenosis, characterized by narrowing at multiple spinal levels, often affects the cervical and lumbar regions and is linked to neurological deficits. Commonly stemming from degenerative or congenital changes, its prevalence increases with aging, especially for cervical myelopathy associated with lumbar stenosis. Diagnosis relies on imaging, with MRI offering precise evaluation of spinal compression and neural impact.
Review: This review examines tandem spinal stenosis management, noting ongoing debate on treatment approaches. While simultaneous decompression minimizes hospital time, staged surgery may reduce complications and tailor treatment to predominant symptoms. For patients with primary lumbar symptoms, cervical decompression has shown to alleviate lumbar issues due to motor pathway organization.
Conclusions: Tandem spinal stenosis requires early diagnosis and individualized treatment, especially as prevalence rises with an aging population. A tailored approach enhances therapeutic outcomes and supports better quality of life for affected patients.

KEYWORDS: Tandem spinal stenosis, cervical myelopathy, decompression

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INTRODUCTION

Tandem stenosis disease is characterized by a reduction in the space of the spinal canal in at least two regions of the spine. In 1987, Dagi et al[1]. described this pathology, associating it with a characteristic triad: intermittent claudication, gait disturbance and radiculopathy.

The etiology of tandem spinal stenosis is due to degenerative changes in the components of the spinal canal or a reduction in the size of the vertebral pedicles. Epidemiological data on tandem pathology vary depending on the author consulted; however, diagnostic suspicion is important to prevent neurological deterioration due to asymptomatic stenotic lesions when decompressing another affected level.

The current treatment is decompression surgery. There is ongoing debate regarding the type of treatment and surgical approach, whether in a single or staged procedure. The objective of this article is to provide a review on this topic.

ANALYSIS

Tandem spinal stenosis is characterized by a reduction in the spinal canal associated with neurological deficits. Brain and Wilkinson described spinal stenosis in the cervical and lumbar regions. Later, Dagi et al[1]. named the association of stenosis with neurological alterations as tandem spinal stenosis[1,2].

Tandem pathology affects at least two regions of the spinal canal[3,4]. It may result from a degenerative process affecting the facet joints or spinal ligaments. Congenitally, it may present as a reduction in the size of the pedicles[5]. Studies conducted in Asia have demonstrated a relationship between ossification of the posterior longitudinal ligament and tandem spinal stenosis [6,7].

The first description by Teng and Papatheodorou mentioned the reduction of the spinal canal in two distinct regions[8]. However, later on, Dagi et al[1]. found a correlation with the clinical triad characterized by intermittent claudication, gait disturbances, and signs of upper or lower motor neuron involvement[9]. These lead to inflammation of the nerve roots and/or irritation of the dorsal root ganglion. Evidence of an inflammatory process, including cytokines and other pro-inflammatory markers, has been demonstrated in perineural

biopsies, serum, and cerebrospinal fluid from symptomatic patients[10].

The existing epidemiological data on tandem pathology are highly variable. In a cadaveric study, its prevalence was estimated to be between 0.9% and 5.4%[11], while other studies calculated it to be 2.05%[12,13]. Asymptomatic compression of the cervical cord in patients with lumbar stenosis has been observed in 24% of cases[11]. In prevalence studies of tandem spinal stenosis using magnetic resonance imaging, a higher prevalence of cervical compression has been noted in patients with lumbar stenosis compared to those without lumbar involvement. The prevalence of cervical myelopathy associated with lumbar stenosis is expected to increase as the population ages, which represents a public health issue[14]. Therefore, it is important to maintain a diagnostic suspicion of asymptomatic cervical pathology in patients diagnosed with lumbar stenosis, as it may progress to myelopathy[15]. Up to 84% of degenerative changes in intervertebral spaces have been observed in asymptomatic patients over 48 years old[16].

Depending on the affected region, tandem stenosis can be classified into four types: cervicothoracic stenosis, thoracolumbar stenosis, cervicothoracolumbar stenosis, and cervical-lumbar stenosis[3]. Thoracic stenosis is a rare condition, which makes early diagnosis and treatment challenging. In cases of multiregional pathology, these can be considered degenerative changes associated with the ossification of the posterior longitudinal ligament and the yellow ligament[17].

Reported cases of spinal stenosis at the thoracic level are less frequent than those recorded in the cervical and lumbar spine; however, they present a poor prognosis due to reduced blood supply, making them more vulnerable to ischemic injuries. Secondly, the thoracic region has a natural kyphosis that limits the movement of the spinal column[18]. An important clinical point to consider is that signs of cervical myelopathy can complicate the diagnosis of stenosis in the thoracic region; in fact, it is difficult to distinguish between these two regions using electrophysiology[19]. The most commonly used diagnostic tools are the Modified Japanese Scale, the Neck Disability Index, and the Nurick Scale[20], in addition to measuring quality of life using the Short-Form-36 (SF-36)[21]. **(Table 1)**

Table 1. The Nurick grading system.

The Nurick grading system	
Grade 0	Signs or symptoms of root involvement, but without evidence of spinal cord disease.
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, but that is not so severe as to require someone else's help to walk.
Grade 4	Able to walk only with someone else's help or with the aid of a frame.
Grade 5	Chair- bound or bedridden.

As a non-invasive and non-ionizing imaging modality that provides detailed resolution of spinal tissues, magnetic resonance imaging is superior to other imaging modalities, such as X-rays[22]. **(Figure 1)**

Figure 1. Images show sagittal T2-weighted cuts in the cervical and lumbar regions, observing a decrease in the space of the spinal canal.

In recent years, several measurements have been conducted on lumbar spinal stenosis; however, these require measurement methods that do not necessarily predict the risk of associated cervical spinal stenosis. van Eck et al[23]. developed a new classification system for congenital lumbar spinal stenosis using magnetic resonance imaging and observed a significant correlation between type III lumbar and cervical spinal stenosis according to the Torg-Pavlov method**. (Table 2).**

Table 2. MRI classification system for congenital lumbar spinal stenosis.	
Type I	Normal spinal canal
Type IIa	Tapering of the spinal with gradual narrowing from the thoracolumbar junction to a peak area of stenosis at L5-S1
Type IIb	Hourglass stenosis with a canal that begins to narrow at the thoracolumbar junction dowm to a peak area of stenosis, typically at the L3-L4 level and then widens again caudally
Type III	Global stenosis. (¨functional lumbar spinal stenosis¨) with a symmetrically narrow canal throughout all lumbar segments with little to no spinal fluid surrounding the conus.

Table 2 . MRI classification system for congenital lumbar spinal stenosis. van Eck et al[23] (2016)

The dimensions of the spinal canal in the cervical region are approximately 17-18 mm in anteroposterior diameter, with a spinal cord occupancy of about 10 mm. When the canal diameter is less than 12 mm, with or without a Torg-Pavlov ratio < 0.8 on lateral X-rays, the probability of myelopathy increases[24]. The diagnostic approach should include the presence of symptoms, as well as processes such as spondylosis and calcification of the spinal ligaments.

Radiological changes were observed in the lumbar region in 50% of patients with degenerative cervical spine disease. Moderate to severe compression of the cervical cord was reported in 24% of patients with lumbar stenosis[25]. In another study, radiological signs of cervical stenosis were observed in 84.6% of patients with lumbar compression and 57.7% in the general population[13]. In some cases of cervical stenosis, the second affected region is often asymptomatic and is not revealed until the primary symptomatic area has been treated[26].

Clinically, the development of myelopathy represents a change in the patient's prognosis. Those who present asymptomatically may be considered myelopathic based on clinical findings indicative of upper motor neuron dysfunction and clinical signs such as Hoffmann's, Trömner's, and Babinski's signs.

The risk of spinal cord injury in the cervical region is high not only due to the presence of asymptomatic stenosis but also due to asymptomatic traumatic injuries in the spinal column. Functional deterioration in patients with cervical myelopathy can be assessed using the modified Japanese Orthopaedic Association scale (mJOA) or the Nurick classification system [27,28,29]. **(Table 3)**

Table 3. The modified Japanese orthopaedic Association scale

The modified Japanese orthopaedic Association scale		
Type of dysfunction	**level of dysfunction**	**Score**
cceMotor	Inability to move hands	0
dysfunction,	Inability to eat with a spoon, but able to move hands	1
upper extremity	Inability to button shirt, but able to eat with a spoon	2
	Able to button shirt with great difficulty	3
	Able to button shirt with slight difficulty	4
	No dysfunction	5
Motor dysfunction,	Complete loss of motor and sensory function	0
lower extremity	Sensory preservation without ability to move legs	1
	Able to move legs, but unable to walk	2
	Able to walk on flat floor with a walking aid (cane or crutch)	3
	Able to walk up and/or down stairs with handrail	4
	Moderate to significant lack of stability , but able to walk up and/or down stairs without handrail	5
	Mild lack of stability, but walks with smooth reciprocation unaided	6
	No dysfunction	7
	Complete loss of hand sensation	0

Sensory dysfunction, upper extremity	Severe sensory loss or pain	1
	Mild sensory loss	2
	No sensory loss	3
Sphincter dysfunction	Inability to micturate voluntarily	0
	Marked difficulty with micturition	1
	Mild- to-moderate difficulty with micturition	2
	Normal micturition	3

Serious complications following spinal surgery may include neurological deficits due to C5 paralysis or hematoma formation. Paralysis can result from stretching of the spinal roots within the foramina during the procedure[30].

Functional outcomes after surgery depend on the severity of cervical stenosis. The severity of compression leads to intramedullary changes that affect surgical outcomes and are associated with a poor postoperative prognosis[31,32].

TREATMENT

Tandem spinal stenosis should always remain a differential diagnosis in patients with spinal stenosis, especially if, after initial surgical decompression in one region of the spine, the patient does not show improvement in symptoms, even in the absence of evident myelopathic signs[33].

Due to the aging population, an increase in the incidence of degenerative cervical myelopathy is expected, which requires spine surgeons to make decisions about the need for surgical management more frequently. The goal of decompression is to halt the progression and worsening of symptoms. Unfortunately, most patients present for initial evaluation late due to painful syndromes from degenerative disease[34], which necessitates a high index of diagnostic suspicion to identify possible pathology in another region of the spine and predict functional decline associated with cervical myelopathy[35].

The symptoms present in tandem spinal stenosis can manifest in both the upper and lower extremities, which generates controversy in the surgical strategy[36]. Stage surgery has been recommended in most studies due to its lower invasiveness and relative safety. However, the preferred order of surgical treatment remains a controversial topic[36]. For some surgeons, it is preferable to initially perform cervical decompression, as the decompression of lumbar tracts that pass through the cervical region may improve lumbar symptoms[37]. This is due to the somatotopic organization of upper motor neurons from the motor cortex to their respective nerve roots, which could explain the dramatic improvement in lumbar pain and radiculopathy observed after cervical decompression.[38] In the study reported by Taro Inoue et al[39]., 64 patients with tandem spinal stenosis and predominant lumbar stenosis symptoms were analyzed. Cervical decompression surgery was performed, and a 69% improvement in lumbar symptoms was observed.

The advantages of performing combined decompression are clear: it requires a single hospitalization and anesthesia, which reduces medical costs. Furthermore, it is encouraging that studies on combined cervical-lumbar decompression have shown that their clinical outcomes are comparable to those obtained through staged decompression[40]. Performing surgical treatment in phases is safe and avoids additional surgeries. According to some researchers, addressing all segments in a single operation results in a more invasive approach, with a higher complication rate and a longer hospital stay[41].

There is controversy regarding which area should be operated on first. Some studies suggest that the area where the pathology is dominant should be treated first, followed by the other; however, others indicate that the cervical region should be operated on first, followed by the lumbar region. Only a few studies have recommended simultaneous decompression of both regions in a single session. Similarly, in tandem stenosis, in the double crush syndrome, where the nerve is compressed at two different levels, optimal results are obtained by performing surgical decompression at both levels[30].

Simultaneous surgery for TSS is comparable to that performed for bilateral total knee or hip replacement. There has been a demonstrated reduction in surgical costs without an increase in perioperative complications or the length of hospital stay[42,43]. Epstein et al[44]. reported on the results of 20 patients with TSS who underwent cervical decompression, finding that 12 patients (60%) experienced improvement in symptoms in the lower extremities, as well as relief from spasticity and myelopathy.

It is possible that decompression of the cervical spine physiologically alleviates the impact on the ascending pathways that cause pain in the lumbar region[45]. Additionally, cervical decompression could provide some improvement in lumbar symptoms, as lumbar neural fibers may also be compromised by cervical spondylotic processes[46].

When both cervical and lumbar stenosis appear equally symptomatic, we typically first address the cervical spine or choose a simultaneous procedure. Initial surgery for cervical stenosis significantly reduces the need for a second-stage intervention. In contrast, if lumbar stenosis is treated first, a notable exacerbation of symptoms associated with cervical stenosis can quickly occur. Therefore, the initial approach to cervical stenosis seems more appropriate[47]. However, in patients without myelopathy, it has been suggested that treatment can reasonably begin with decompression at the most symptomatic level. Proponents of the initial lumbar

approach argue that correction at the lumbar level may improve cervical flexion[48].

Furthermore, maintaining patients in prolonged surgical positions, such as prone or lateral, during procedures related to lumbar spinal stenosis (LSS) may result in exacerbation of cervical compression and increase the risk of neurological damage[15]. Additionally, in neurologically intact patients whose main complaint is lumbar pain or pain in the lower extremities, lumbar decompression alone achieves functional outcomes similar to or even superior to those of combined cervical and lumbar decompression. Therefore, surgical decompression in stages is recommended, prioritizing the lumbar region in patients with tandem spinal stenosis (TSS) and predominant lumbar compression[49]. In the absence of persistent symptoms or the appearance of localizable clinical signs in the cervical region, patients may not require additional surgical decompression[50].

CONCLUSION

Tandem spinal stenosis presents a diagnostic and therapeutic challenge, particularly in patients with both cervical and lumbar involvement. Surgical approach decisions should be individualized based on the predominant symptoms and the patient's neurological status, weighing the advantages of simultaneous decompression against the benefits of staged treatment. With an aging population, the prevalence of this condition is increasing, underscoring the importance of early diagnosis and a comprehensive treatment plan to improve functional prognosis and patient quality of life.

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