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A SPINAL CORD STENOSIS: DIAGNOSIS, SYMPTOMS &MANAGEMENT

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Abstract
The reason behind lumbar spinal stenosis (LSS) is narrowing of the space within the vertebral canal and/or intervertebral foramina. The spinal cord and potentially the spinal nerve roots compress as a result. Two of the most common symptoms of spinal stenosis are lower back pain and neurogenic claudication (NC). Patients suffering from lumbar spinal stenosis may also have radiating discomfort, back pain, and neurogenic claudication. Surgery can have positive results like instant symptom relief and a decreased chance of falls, even though both nonsurgical and surgical interventions have similar long-term outcomes. Basically, surgical treatment comprises of decompression; additional therapies may be added depending on the degree of decompression and related instability. Because it can have a major negative impact on both quality of life (QOL) and activities of daily living (ADL), lumbar spinal stenosis (LSS) is one of the major health issues in an aging society. The ten-year history of LSS symptoms for 1149 participants was investigated. When imaging data, like magnetic resonance imaging, was not available, LSS symptoms were measured using a specially designed and validated questionnaire.
Keywords: spinal stenosis, neurologic claudication, back pain, LSS.

Introduction

Degenerative lumbar spinal stenosis refers to the narrowing of the spinal canal due to degenerative changes in spinal joints, intervertebral discs, and ligamentum flavum. As the space surrounding the neurovascular tissue becomes narrower, major clinical symptoms may appear, such as neurogenic claudication, radiating pain in the lower extremities, low back pain, and urination– defecation impairment(1). Clinical symptoms may include decreasing sensation and fatigue in the lower extremities, as well as increasing pain in both buttocks or lower limbs, which may worsen when walking or standing for a long time (neurogenic intermittent claudication). Patients may experience alleviation of symptoms when they sit or bend forward, and if the pain caused by a walking or standing posture becomes severe, it maybecome difficult to perform daily and independent activities or the risk of fall may increase. Lumbar spinal stenosis (LSS) is defined as a syndrome of narrowing of the spinal canal, lateral recess, or neural foramina, which are nervous system pathways, and it causes specific symptoms of the lumbar region and lower limbs. LSS is one of the most serious problems in the elderly because of its high prevalence and negative impact on quality of life (QOL). In addition, it is well known that radiographic findings do not always correlate with symptoms, because anatomic spinal stenosis occurs commonly on imaging in the elderly. Therefore, clinical LSS should be diagnosed through subjective symptoms first, and then finally confirmed through objective physical findings supported by radiographic evidence. Furthermore, there are discrepancies between clinical symptoms and imaging findings such as stenotic condition on magnetic resonance image (MRI) in cases of LSS. Due to these complexities of the diagnosis of LSS, it has been difficult to conduct a large-scale epidemiologic study of LSS. The prevalence of symptomatic LSS in community-dwelling people was reported using a self-administered, self-reported history questionnaire for LSS (LSS-SSHQ). This tool was specially designed to detect LSS symptoms without image information such as magnetic resonance

imaging (MRI) and has been analyze in derivation and validation studies and has been confirmed to have acceptable sensitivity, specificity, and reproducibility.

History:

Lumbar spinal stenosis is often asymptomatic. Studies have reported no close association between clinical symptoms and anteroposterior diameter of the spinal canal. The natural course of lumbar spinal stenosis in the majority of cases includes gradual developmentof symptoms; however, in some cases, it becomes acute following some trauma or severe physical activity. In several patients, even when imaging tests lead to the diagnosis of stenosis,symptoms and physical examination may only reveal negligent abnormalities. Several studieshave reported that patients who received surgical treatment, such as decompression, exhibit better progress than those who received nonsurgical treatment; however, 50% of the patients who received nonsurgical treatment and were followed up for 8–10 years showed improvements in back pain and leg pain(2). In a prospective randomized study involving 100 patients with symptoms of stenosis who were provided surgical or nonsurgical treatment, it wasobserved that symptoms improved after approximately 3 months irrespective of the type of treatment, and some patients showed symptom improvement after 12 months. In the nonsurgical treatment group, symptoms worsened over time, but after 4 years, approximately 50% of the patients displayed excellent or fair progress. In contrast, 80% of the patients who received surgical treatment exhibited good results at the 4-year follow-up.. According to Weinstein et al, the surgical treatment group showed improvement in all primary outcomes compared with the nonsurgical treatment group.

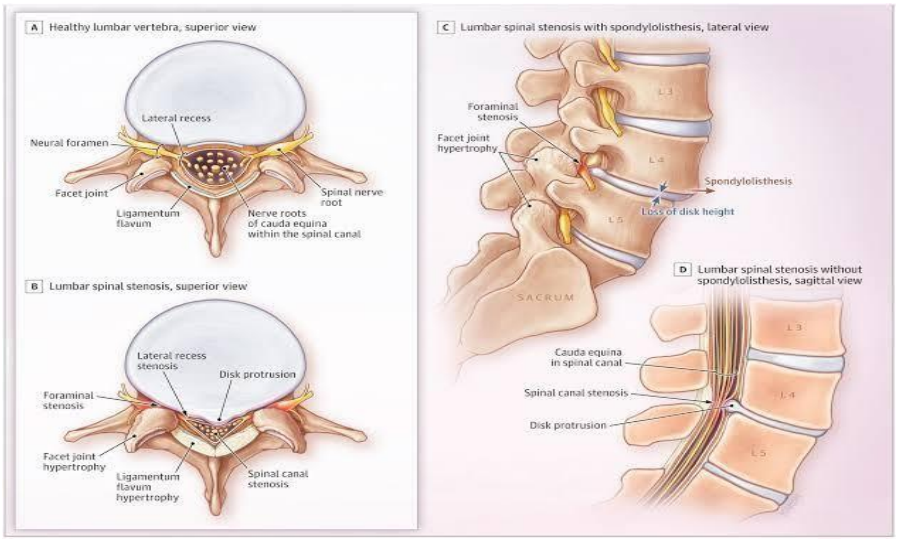


Figure1; Patho anatomy of degenerative lumbar spinal stenosis.

CT can be used for persons with contraindications to MRI. Some authors have proposed formal quantitative criteria for lumbar spinal stenosis on MRI. A spinal canal cross-sectional area lessthan 191mm2has sensitivity of93% and specificity of 45% for lumbar spinal stenosis.15 A spinal cross-sectional area of less than 147 mm2has sensitivity of 75% and specificity of 79%.15.

Methods and Material

In this study, the LSS-symptoms survey was combined with annual health checkups of residents enrolled in the National Health Insurance system in Tadami town, Ina village, and Tateiwa village in Fukushima prefecture, Japan. Of the 3367 people who participated in the health checkups, 1862 (697 males, 1165 females; age range, 19–93 years) were followed up for the LSS survey, which corresponds to 21.5% of the 8660 people in the survey area, and 55.0% of those who participated in the health checkups(3).

Ten-year follow-up survey was performed in 2014. In this 10-year follow-up study, a questionnaire was mailed to the subjects for them to complete. Then, a volunteer visited each subject to collect the questionnaires. Participants were excluded if they were unable to walk independently, fill out the questionnaires due to visual impairment, had ever undergone brain or spinal surgery, or had experienced a fracture of the lower extremities in the year previous to the start or the follow-up of the study period.

Anatomy and Pathophysiology

Anatomy: Lumbar spinal stenosis is classified according to the anatomical location in which the spine is affected or to the etiology. In degenerative lumbar spinal stenosis, the redundancyand loosening of yellow ligaments due to the narrowing of the disk space result in the narrowing of space in the spinal canal, which may be accompanied by instability.(4)

Variable	Classification
Anatomic	
Anatomic area	Anatomic region (local segment)
Cervical	Central
	Foraminal
Thoracic	Central
	Lateral recess
	Foraminal
	Extraforaminal (far-out)
Pathologic	
Congenital	Achondroplastic (dwarfism)
	Congenital forms of spondylolisthesis
	Scoliosis
	Kyphosis
Idiopathic	-
Degenerative and inflammatory	Osteoarthritis
	Inflammatory arthritis
	Diffuse Idiopathic skeletal hyperostosis
	Scoliosis
	Kyphosis
	Degenerative forms of spondylolisthesis
Metabolic	Paget disease

Fig no 2 classification of spinal stenosis

This relative hypermobility causes overgrowth and thickening of the posterior facet joints andsurrounding ligaments. The yellow ligaments can thicken, especially in the area where they areattached to the spinal articular capsule around the lateral recess, which may compress the nerve roots. These processes occur individually or simultaneously, resulting in symptoms of lumbarspinal stenosis. Central stenosis refers to the narrowing of the space between both the posterior facet joints, primarily the space occupied by the dura sac and internal neuralstructures. The stenosis of this region is caused by the intervertebral disc extrusion, bulging ofthe annulus fibrosis, osteophyte formation, and folded or thickened yellow ligaments. Symptomatic central stenosis results in neurogenic claudication with pain in the lower extremities.(5)

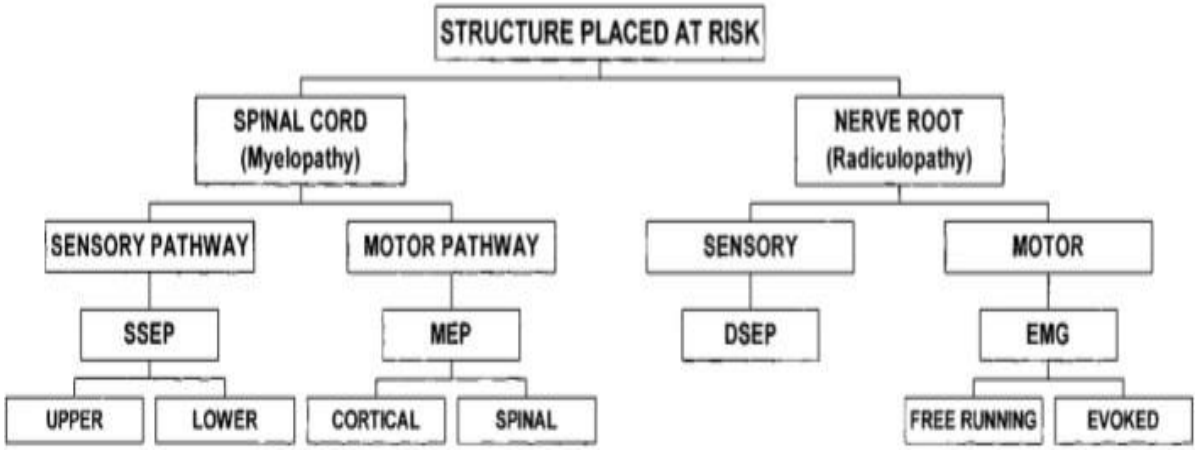
Pathophysiology:

Degenerative lumbar spinal stenosis is a progressive disease that involves all the movement segments of the spine. The relative instability initiated by degeneration of the intervertebral disc leads to hypermobility of the vertebral segments, resulting in increased pressure on the posterior facet joints, followed by a narrowing of the intervertebral disc space,an increased extension angle, and hypertrophy of the facet joints, especially the hypertrophy ofthe superior articular process. The cauda equina nerve roots gain metabolic energy from the blood circulation of the arteries located on the surface of nerve roots and the diffusion of cerebrospinal fluid. In lumbar spinal stenosis, when the nerve roots are under increased pressure in the spinal canal, neural ischemia and defective nerve conduction can occur. Symptoms can also occur due to venous congestion and may contribute to the etiology of lumbar spinal stenosis involving two or more segments. If the nerve roots are damaged, centralsensitization of pain perception can occur, which can result in chronic pain(6).

Types of Potentials:

Somatosensory Evoked Potentials:

The potential for postoperative myelopathy after spine surgery is well known and documented. Depending on the surgical manipulation, injury to sensory and/or motor pathwaysof the spinal cord is possible. (7)



Fig; Organizational chart of basic protocols used in intraoperative spinal cord and nerve rootmonitoring. SSEP somatosensory evoked potential; MEP motor evoked potential; DSEP dermatomal sensory evoked potential; EMG electromyography.

- The somatosensory evoked potential monitors the functional integrity of dorsal and lateral columns of the spinal cord. Although the somatosensory evoked potential does not monitor motor pathways directly, mechanical injury to motor tracts may affect neighboring sensory fibers, which then may affect the somatosensory evoked potential. Although there is good correlation between intraoperative somatosensory evoked potential status and motor function, uneventful sensory studies do not guarantee an intact motor system., vascular abnormalities, and correction of spinal deformity.5,20,49,55 Motor potentials typically are not used in surgical procedures where risk for injury to the motorpathways is relatively low. (8)
- Dermatomal Sensory Evoked Potentials

The dermatomal sensory potential is the response of the somatosensory cortex to repetitive stimulation of a peripheral dermatomal field.7,37,51,52,64 The dermatomal potential assesses the functional integrity of sensory nerve roots that innervate the sensory field. In most situations, the dermatomal potential has a good degree of specificity to the level of involvement. (9)

The dermatomal potential is not recommended for monitoring nerve root integrity during lumbar decompression18. First, similar to evoked somatosensory and motor potentials, the dermatomal response is an averaged potential that does not provide instantaneous feedback regarding the functional integrity of a nerve root.7,51,52 This is a serious shortcoming because real-time studies are essential to protect nerve roots during ongoing surgical manipulations. Second, dermatomal evoked potential data are not very reliable and are subject to various limiting factors such as inconsistent patterns of nerve root co innervation,effects of anesthesia, and the patient's history of radiculopathy.25,36,51,53,68,72 Finally,the dermatomal potential assesses sensory function only. For all these reasons, the dermatomal sensory evoked potential is not considered a viable option for monitoring nerveroot function during surgical treatment of lumbar stenosis(10)

Treatment

Randomized clinical trials of treatments for lumbar spinal stenosis are summarized in Further information on the outcomes measures for each trial, including the minimal clinically important difference (MCID) is provided in e Table 1 in the Supplement.(11,12) Table 2 summarizes these effectiveness data. Patients with lumbar spinal stenosis generally benefit from an explanation of the relationship between posture and symptoms20. To avoid exacerbating symptoms, clinicians may suggest exercises (such as biking or swimming side stroke) that aretypically carried out in a lumbar flexion position.(13) Althoughmany studies have assessed the effectiveness of nonsteroidal anti-inflammatory medications (NSAIDs), acetaminophen, and other medications in patients with low back pain,40,45 there is little research on the effectiveness of thesemedications specifically in patients with lumbar spinal stenosis. Findings from studies of other spinal disorders, such as nonspecific back pain and disk protrusion, should be applied cautiously to patients with lumbar spinal stenosis.(14,15)

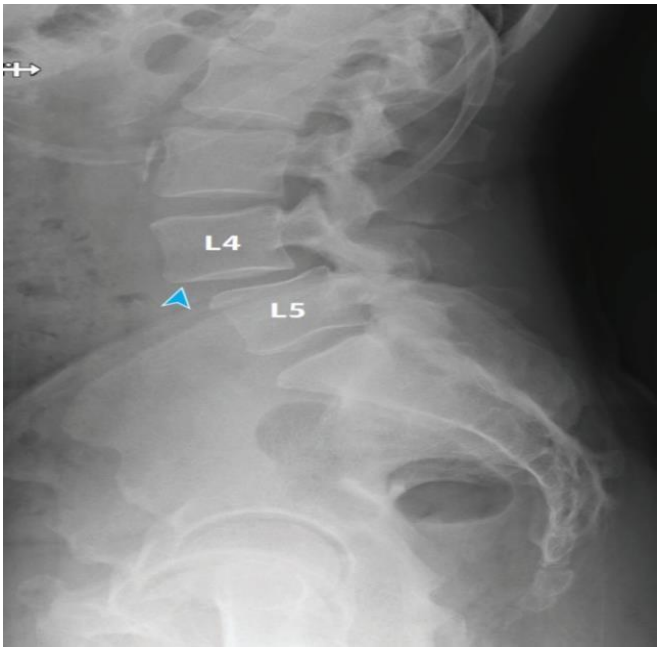


Fig 7; Plain Radiograph Showing L4-5 Spondylolisthesis in a 71-Year-Old Man.

Diagnosis:

Epidural Steroid Injection:

An intermediate step between conservative and surgical treatments. Spinal stenosis can result in nerve edema due to structural and chemical stimulation of the nerve roots caused by physical compression of the nerve tissue and nerve root inflammation due to local ischemia caused by congestion of venous blood around the nerve roots, which may lead to the release of phospholipase or leukotriene B, worsening inflammatory reactions, and edema(16,17). The purpose of epidural steroid injections for stenosis is to induce a strong anti- inflammatory action to reduce the inflammatory response and edema through the reduction of leukocyte migration, inhibition of cytokine production and release, and cell membrane stabilization. (18)In several studies, epidural steroid injection treatment was found to produce a short-term relief of symptoms in approximately 50%–87% of the cases. Indications for epidural steroid injections include acute radiating pain and neurological claudication that interfere with daily life, despite the administration of pain relievers and rest, which are anticipated to improve the symptoms. There are also reports of recent studies using epiduralneuroplasty and other combination of drugs such as ropivacaine and dexmedetomidine related to thoracolumbar surgery.

1. Principles of Spinal Stenosis Surgery:

The decision to perform surgery is based on the complaints of loss of ability in daily life, such as limited walking due to pain, weakening of the muscles, or paresthesia in the buttocks or lower extremities after adequate conservative treatments for at least 2–3 months. Surgeries are rarely performed for lower back pain that is caused only by spondylolisthesis and scoliosis without instability. Although rare, even when long-lasting motor nerve palsy is the only symptom, other causes must be identified before performing surgery because of the difficulty of predicting the likelihood of recovery after surgery. In case there exists a relatively rapidly progressing nerve impairment or loss of urination– defecation functions, early decompression is required. When deciding on surgery, abnormalfindings from CT or MRI imaging should match the patient's symptoms. The principle of surgical treatment is sufficient decompression of nervous structures.

When decompression is performed, care should be taken to reduce the risk of dural damageby checking for adhesion of the neural membrane that may exist even without a history ofsurgery. When the stenosis of the lateral recess and foramen is very severe, caution is required during decompression as it may result in neural damage with surgical devices.

Symptoms;

- Pain (unilateral or bilateral) radiating from the low back to below buttocks
- Pain relieved with sitting
- Pain reduced when leaning on shopping cart
- Poor balance

Results and Discussion:

We started an epidemiological study of LSS from 2004. In the initial survey,the prevalence of LSS symptoms increased with age, and the presence of LSS symptoms reduced low back pain-related QOL and health-related QOL. Up to now, there is few studies regarding time course of LSS in the community. This study was conducted to reveal the time course of LSS symptoms in community-dwelling people over a 10-year period. When considering an intraoperative monitoring protocol for surgical treatment of lumbar stenosis, simultaneous monitoring of somato sensory evoked potentials and nerve root specific electromyography provides coverage of sensory and motor components of spinal cord and nerve root function. Somatosensory evoked potentials have been shown to be sensitive, reliable, and effective measures of overall spinal cord function.1 The criteria for significant change in the somatosensory evoked potential waveform (10% latency increase, 50% amplitude decrease) are well defined and established. Moreover, the somatosensory evoked potential is minimally invasive, simple to set-up, and easy to record. (20)

Conclusion

This literature review examined the current pain management interventions for LSS and detailed the various strategies to help patients. Physical therapy, medications, and procedures, such as epidural injections, are non-invasive interventions that can alleviate symptoms and have consistent evidence to support their use. Patients with severe symptoms and/or neurological deficits will often require surgeries, such as laminectomies. However, proceeding with surgery requires a careful discussion between the patient and the surgeon regarding the potential risks and benefits. There are newer devices and procedures, such as intervertebral spacer devices, and procedures, such as MILD, that may allow patients to avoidthe risks of surgery and experience symptom relief.

Author contributions

All authors are contributed equally.

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Declaration of Competing Interest

The authors have no conflicts of interest to declare.

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