

Degenerative Lumbar Spinal Stenosis. When and How Should We Operate On

Thomas Patsiaouras

Former Director Orthopaedic dpt, Asklipiion Hospital - Voula-Athens

ABSTRACT

Lumbar Spinal Stenosis is a degenerative spinal condition affecting 50% of patients usually over 50 years. Is considering the end result of the degenerative cascade with compression of neural tissues by disc displacement anteriorly and by hypertrophy of facet joints and ligamentum flavum posteriorly. The main symptom except Low Back Pain and sciatica is the Intermittent Claudication. There is no always correlation between clinical symptoms and the degree of stenosis in imaging studies. The natural history of LSS is unpredictable but some patient can be benefitted by the conservative treatment. We have to be aware from Cauda Equina Syndrome which is more insidious in LSS. Treatment options range from conservative to surgical according the degree of stenosis and the severity of clinical symptoms. In this article are described the surgical techniques for decompression and the indications for concomitant arthrodesis in cases of instability and deformity.

KEY WORDS: Low Back Pain, Stenosis, Intermittent Claudication, Arthrodesis

Introduction

Lumbar Spinal Stenosis (LSS) is a common disease, that affects usually people over 50 years old. It is a degenerative disease causing changes, in the disc, ligamentum flavum and facet joints with aging, leading to narrowing of the Spinal Canal. First described by H.Verbiest, (1954) as a developmental narrowing of the Lumbar vertebral canal.

The narrowing of the Central canal, lateral recess and foramina, produces symptoms of pain in the legs and back.

The main symptom that forces patient for medical consultation and spine surgery is neurogenic clau-

dication, which is aggravated with prolonged walking and standing relieving by sitting and flexion, due to the central canal stenosis.

When the lateral recess and neural foramina are narrowed, gives rise to symptoms of lumbar radiculopathy.

So the spinal stenosis is distinguished in central and lateral. (1) One of the causes of LSS is the loss of Lumbar Lordosis due to degenerative Disc disease. This leads to hyperextension to compensate with a final result an unbalanced spine. (Fig. 1)

Spinal stenosis is considered as a significant cause of disability in the elderly and the most usual in-

CORRESPONDING
AUTHOR,
GUARANTOR

Thomas Patsiaouras MD
Former Director Orthopaedic dpt, Asklipiion Hospital - Voula-Athens
Mobile phone: 6944566770, 6945412449
thomas.patsiaouras@gmail.com

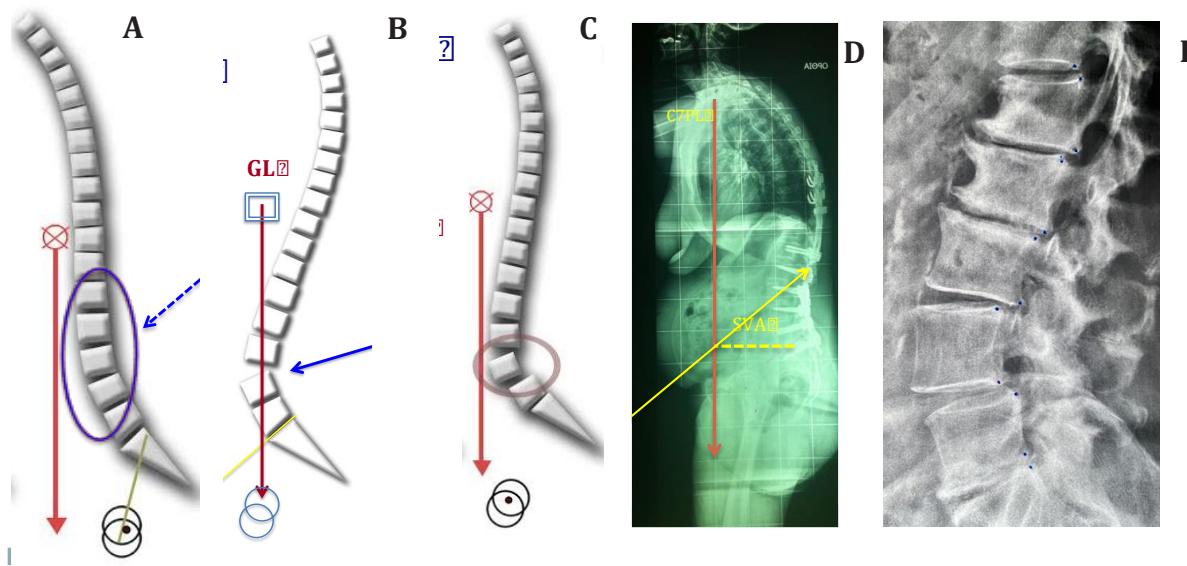


Fig 1. A Loss of Lordosis. B. Reaction by hyperextension. C. Compensation. D. Unbalanced spine. E. Retrolisthesis, Spondylolisthesis Unbalanced Spine

dication of spinal surgery in patients over 65 years old.

Clinicians should be very careful, first to diagnose and second to treat LSS effectively.

Etiology:

With aging there is significant degeneration of the intervertebral disc that protrudes posteriorly affecting the mechanical balance of the spinal unit, leading to increased loading of the posterior elements of vertebra (Facet Joints).

These changes lead to osteophyte formation, facet joint hypertrophy, synovial cysts and ligamentum flavum hypertrophy and buckling, which in turn cause spinal stenosis.

Epidemiology

The prevalence of LSS is estimated to be 9% in the general population and up to 47% in people older than 60 years.

Has described by Verbiest as an anatomical concept to a poorly defined Clinical Syndrome.

There is a lack of universally accepted definition of LSS and is difficult to determine the exact epidemiology. In a study (ancillary Framingham Study) (1) where subjects underwent a CT-Scan to deter-

mine the central AP diameter of the spinal canal, absolute LSS was defined as diameter <10mm. The prevalence of acquired Lumbar Stenosis was 19.4% for population between 60-69 years and increases with ageing

Developmental Stenosis

Lumbar Spinal Stenosis can be related to congenital malformations of the posterior structures of the Spine which are manifested as Short pedicles and laminae. (2)

In Developmental Spinal Stenosis pre-exists a narrowed spinal canal that makes the neural elements prone to compression and hence stenosis symptoms. The imaging and clinical presentation is similar to degenerative type. Patients may experience claudication and radicular symptoms at multiple levels similar with patients suffering from achondroplasia. Due to multiple levels of narrowing, this group of patients are more susceptible to restenosis after surgical treatment. It is known that the pedicle as a unique structure has increasing widths progressing from cranially to caudally. This explains why the stenotic manifestations are in the Lower Lumbar Spine and especially at L4-L5, in comparison with L5-S1 segment which is more stable due to stabili-

zation effects on L5 vertebra by the iliolumbar ligaments. Many papers suggest that developmental stenosis play an important role in lumbar spinal stenosis. Critical stenosis has been defined as <14mm at L4, <14mm at L5 and <12mm at S1 (3)

Diagnostic Criteria

There is an heterogeneity of the condition and standard criteria for diagnosis.

Lumbar Spinal Stenosis (LSS) is currently recognized by North American Spine Society as a clinical syndrome of buttock or lower extremity pain which can occur without back pain, associated with diminished space available for the neural and vascular elements in the lumbar spine. ISSL 2019, (4) Deyo et al 2010)

Currently diagnosis is based on a complex integration of factors, including history, physical examination and imaging studies.

In order to be able to refine outcomes assessment and to have more cost effective and targeted clinical care, it is imperative to define a core set of Diagnostic criteria.

In the absence of valid objective criteria it has been suggested that experts opinion be considered the criterion standard for diagnosis LSS.

According the ISSLS paper (4) a set of questions was sent to international experts (20 spine surgeons) on which factors obtained from the history, are the most important for clinical diagnosis of LSS.

The results suggest, that within six questions, clinicians were 80% certain of diagnosis.

The most important history item, including leg or buttock pain while walking, flex forward to relieve symptoms, feels relief when using a shopping cart or bicycle, and motor or sensory disturbance while walking, normal and symmetric foot pulses, lower extremity weakness and low back pain.

Evaluation

There is no doubt, that in patients with a history and physical examination findings consisted with LSS, MRI suggested as the most appropriate and non invasive test to confirm the presence of anatomic narrowing of the spinal canal or the presence of nerve

root entrapment (NASS). While MRI is considered the Gold Standard, the CT-Scan is helpful in recognizing the bony structures and to plan screw insertion in cases of instrumented fusion. (5)

CT-Myelography is an option when MRI is contraindicated.

Many authors use an intraspinal canal area of less 76mm² and an AP diameter of <10 mm to characterize moderate to severe LSS. Many times we need a truncal or full body X-Ray to assess the sagittal balance (Fig.2)

On the other hand we must to know that LSS is a common radiological finding in people over 60 years old and there is a lack of correlation between the severity of imaging studies versus the symptom severity reported by patients.

In a study by Boden, (1990) MRI findings of asymptomatic subjects older than 60 years were found to be abnormal on 57% of scans and up to 21% had radiological spinal stenosis. EMG and nerve conduction studies are also used to aid the diagnosis, but mainly to distinguish, polyneuropathy, radiculopathy or other peripheral nerve disorders. EMG exams are often normal in patients with LSS and the decision to proceed or not to decompressive surgery it is not possible to rely on it.

Treatment Options

Conservative vs Surgical treatment

The aim of management of LSS is to reduce symptoms and improve the functional outcome.

Conservative treatment is considering as the first line treatment for this condition.

The usual conservative treatment options consisted of various approaches, including non-steroid anti-inflammatory drugs, epidural injections, physiotherapy, lifestyle modifications and multidisciplinary rehabilitations programs.

The problem with conservative treatment arises, when comparing the results with the surgical treatment, because there is no a description of the specifics of non operative treatment or what kind of physiotherapy was applied.

There is no a real protocol of the different modalities applied in various ways and case by case.

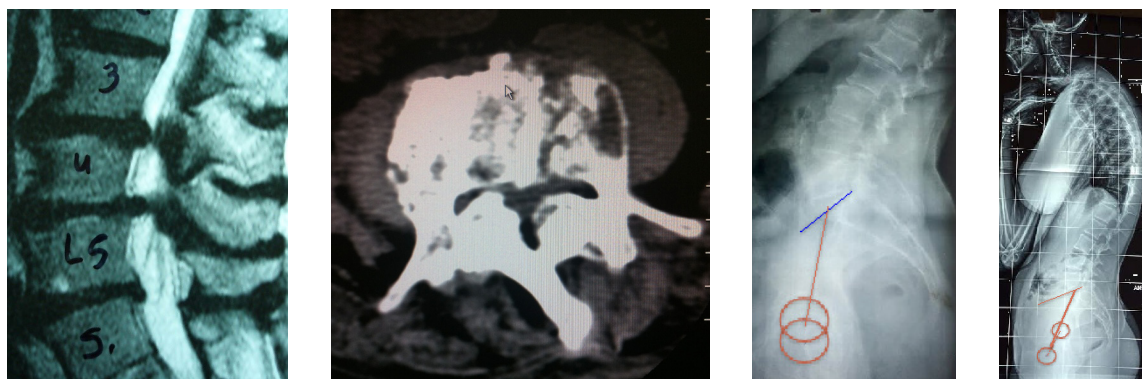


Fig. 2 MRI and CT-Scan of LSS. Plain X-Rays are essential especially whole body in upright position to study sagittal balance

On the other side, it is understandable that conservative treatment approaches are multimodal involving different manipulations

Whereas for the surgical procedures there is available a very precise description in all the included studies, the prescription of conservative treatment is poor or absent in all studies.

In a paper by Kovacs et al (6) Spine 2011, in a systematic review of randomized trials comprised five high quality RCTs, including 918 patients, comparing surgery (Interspinous devices or decompressive surgery with or without fusion) versus miscellaneous conservative treatment that had failed for 3-6 months, the conclusion was that decompressive surgery with or w/o fusion and an interspinous device are more effective than continued conservative treatment for radicular pain due to spinal stenosis.

In an other study by Gen Inoue et al (5) 2016 comparing surgical and non surgical treatment for LSS (Review of numerous studies including RCTs) the decompressive surgery has the strongest evidence base for patients with LSS who do not improve after conservative treatment.

In a systematic review by Fabio Zaina et al (7) Spine 2016, from 12.966 citations they included five RCTs with 643 participants (322 surgical 321 non operative)

In this review there is a disagreement with other studies, where they found more evidence in favor of surgical approach.

-Their conclusion was: Current evidence by comparing surgical vs non surgical treatment care for

LSS is of low quality and it cannot conclude whether surgical or conservative approach is better for LSS nor can we provide new recommendation to guide clinical practice. Given the high rates of side effects (10-24%) associated with surgery, clinicians should be cautious when proposing surgery and patients properly informed about the risks.

-On the other hand, we know that there is severe and mild lumbar stenosis with mild or severe symptoms.

There is no a standard morphologic description in the RCT studies for the group which underwent the standard decompressive surgery. So when speaking for RCTs studies it should be a randomization of the patients irrespective of the spinal stenosis severity. But this is an unethical randomization, by knowing in advance that severe stenosis is not going to lead in a improved outcome.

Indications for Surgical Treatment

It depends on clinical symptoms. As was already mentioned, the classical symptom in LSS is the neurogenic claudication. We have to clarify if there is any sciatica. LBP or other symptoms. Before decided to proceed with surgery, a period of at least 6 months of conservative treatment of any kind, is preceded.

The patient is submitted in a full range of imaging examination, despite the MRI is suggested as the most appropriate and non invasive test, to confirm the narrowing of the spinal canal and foramina.

Plain X-Rays dynamic or not and CT-Scan are

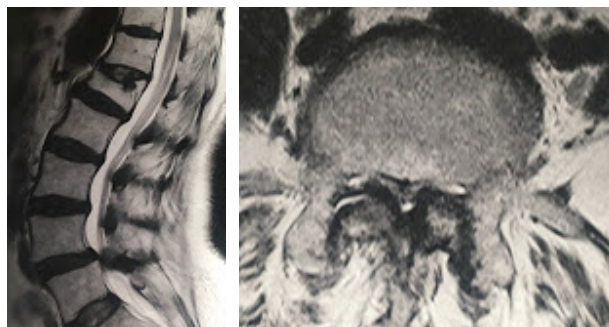


Fig. 3 Deg. Spondylolisthesis

very helpful to recognize a deformity (Scoliosis degenerative or existed) and any kind of instability, like Degenerative or Lytic spondylolisthesis.

The clinical symptoms must correlate with imaging pictures.

But is it the rule? The answer according the literature is no. This is because the AP diameter and cross sectional area fail to take into account the degree of nerve root entrapment.

-In a paper by Clemens Weber et al (8) (Spine 2016) they concluded that there is no association between severity of Spinal Stenosis on pre-op MRI and pre-op Disability, pain or surgical outcomes. There is no clear correlation and should not be overemphasized, and clinical factors are more important than imaging findings for deciding surgical treatment or predicting outcomes.

In the MRI picture (Fig 3) is depicting a Lady 85 years old today with LSS due to degenerative Spondylolisthesis L4-L5, diagnosed 10 years ago, without aggravation in clinical and imaging picture. (Schizas Classification D)

-In order to decide a Decompressive surgery, we have to rely in objective criteria except the clinical ones. As already mentioned the AP diameter and cross sectional area it is not possible to guide us, because fails to take into account the degree of root entrapment.

So a decade ago has been proposed a morphological classification that grades the CSF content of the spinal canal. This helps for clinical decision making and is linked with the risk of failure of conservative treatment (Fig.4)

They defined (K.Schizas et all Spine 2010) (9) grade A as no or minor stenosis. Grade B as moder-

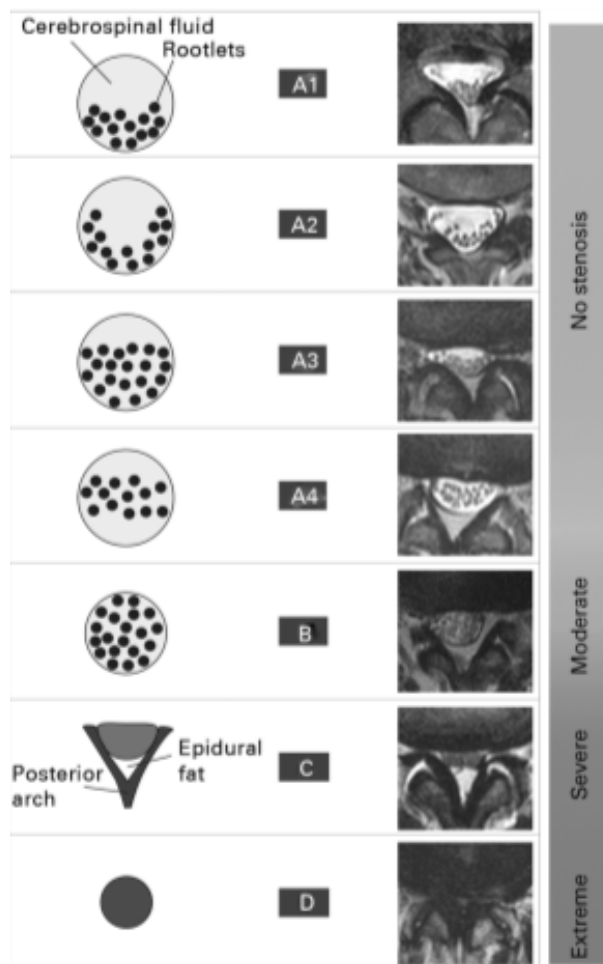


Fig 4. K.Schizas's Classification of LSS. Courtesy by prof K. Schizas

ate stenosis, C as severe stenosis and D as extreme stenosis. According the classification Grade C and D is an indication for surgery.

Surgical Treatment Options

The decision is based on symptoms severity. Which is the main symptom? Low Back or Buttock Pain, Neurogenic Claudication, Radiculopathy or all of them. How we can address it?

The second question or dilemma, if there is any concomitant deformity, as Degenerative Scoliosis or Sagittal Imbalance, or Lumbar instability (Degenerative or Lytic Spondylolisthesis). Decompression is considered the natural treatment or the gold standard, but simultaneous arthrodesis has been advocated by those who believe that pain is related to osteoarthritic changes at the facet joints. Fig.5

The rational for sole decompression

The stability of the decompressed spine can be maintained with meticulous operative technique. This is based on, to pay attention and respect on removing <50% of the facet joints. Kanamori et al (10) proposed the Trumpet Technique with preservation at least 50% of the facet joints. (Fig 6)

Kleeman et al 2000 (11) proposed the "Port-Hole" Technique with laminectomies in both sides, preserving the facet joints (Fig.6)

In addition in the elderly patients, the degenerative changes, (Decreased Disk Height, osteophytes, calcified ligaments) increase the stability of the Spin

The Rational for Concomitant Arthrodesis

Arises from the necessity to treat the LBP or Instability caused by degenerative or Isthmic Spondylolisthesis, degenerative scoliosis and Sagittal Imbalance. Especially for Degenerative Spondylolisthesis one of the main causes of central and lateral spinal LSS, there is abundant literature, proposing concomitant arthrodesis. On the other hand there is an international debate, to fuse or not to fuse after decompression, because sole decompression can lead to further destabilization.

There is a rule, supported by many authors, by making dynamic X-Rays in flexion-extension and if there is a translation >3 mm and >10° angular deformity, then the indication is to fuse. There is and an other opinion supported Fusion, and proposed by Postacchini et al Spine 1991, that continuous motion at the stenotic segment may produce osteophytes and bone regrowth or progressive translation and compression of the nerve roots.

Conventional Laminectomy

There is concern how much Laminectomy can cause damage to the posterior structures, that provide stability. (Facet joints, Ligaments and paraspinal muscles)

Geio et al Spine 1999 had proved that traction of paraspinal muscles >80 minutes can provoke reduction of muscle strength by 50% at six months, leading to LBP.

To avoid this unwanted evolution, other approaches have been invented.

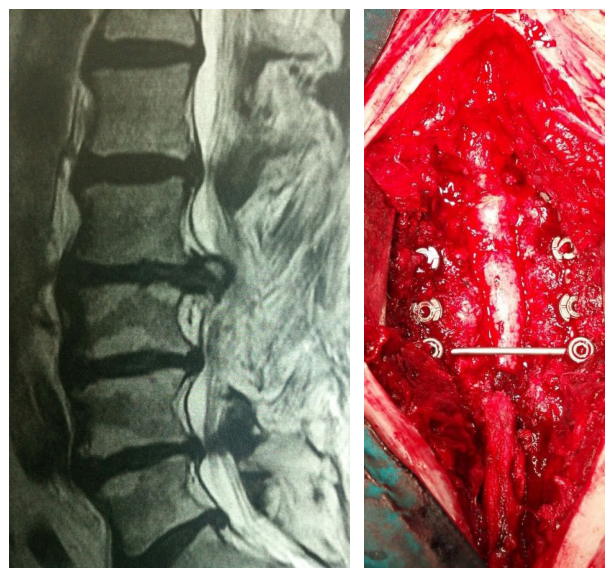


Fig.5 Lumbar Decompression plus Fusion

Spetzger et al 1997 (12) described the bilateral decompression via unilateral laminotomy (Fig.7) without any damage to the supraspinous and interspinous ligaments and paraspinal muscles avoiding with this approach LBP.

It is called cross over or over the top technique. It is essential the surgical microscope and the main indication is bilateral central stenosis w/o foraminal.

Conventional Laminectomy vs Unilateral Laminotomy

In a recent RCT study by Sanbong et al 2019 (13) they randomly divided 50 patients who met the inclusion criteria, central canal stenosis, in two groups.

Group C conventional Laminectomy and Group U unilateral laminotomy. They followed and evaluated them at 2 years, by using VAS, ODI, Rolland Morris Disability Questionnaire and SF-36 form. Their conclusion was, except the shorter operative time, for Group U, there were not significant differences in terms of LBP, Buttock pain, radiating leg pain or functional outcome. Fig.8

Sole Decompression vs Decompression plus fusion

This is one of the biggest debates in the international literature and one of dilemmas in decision making for all spine surgeons.

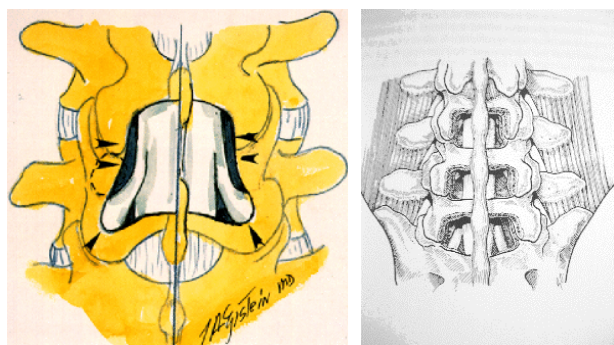


Fig 6. Trumpet and Port Hole Technique. By Kanamori et al Ref 10 and Kleeman et al Ref 11

Have been explained the cons and prons for adding fusion in a simple stenosis.

Many years ago Wiltse 1976 wrote: Iatrogenic Spondylolisthesis never occurs in degenerative stenosis where, there is no degenerative spondylolisthesis before operation.

However, this could happen in laminectomies with medial facetectomies between 8-31% 40 mo to 5,8years F.U (Fu et al Spine 2008, (14) and Fox et al J.S Spinal Disorders 1996)

Do we need to fuse all radical laminectomies and can we decompress the lumbar spine without destabilizing it ? (Fig 9)

According a Swiss paper (N.Ulrich 2017) (15) with 135 patients followed for 3 years, 85 underwent decompression alone and 46 decompression plus fusion.

Both groups benefitted from surgical treatment. Fusion surgery was not associated with a more favorable outcome.

This is in agreement with a study by P.Forsth (16) where in a retrospective study with over 5000 patients there was not any significant difference between the groups. In another study by Eric Tye 2017 (The Spine Journal) (17) the addition of fusion had a negative impact in worker compensation patients.

The Danish Health Authority gave some recommendations for Lumbar Stenosis. (Rikke Ronsing et al Eur Spine Journal 2019) (18)

1.Symptomatic LSS should include decompression

2.Decompression combined with instrumented fusion is not indicated, as there is no evidence of any beneficial effect in the stable spine.

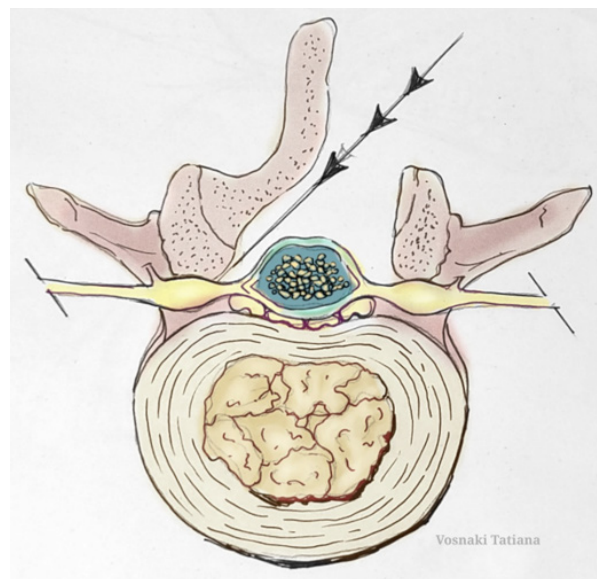


Fig.7. Over the Top technique

The conclusion was, Arthrodesis was not associated with better treatment effectiveness.

In a recent paper by G. Lone et al (The Spine Journal 2019) (19) comparing the surgical practice variation and clinical outcomes in 3 National registries, they found that the rate of additional fusion in LSS patients with and w/o spondylolisthesis was in Norway 11%, Sweden 21% and Denmark 28%.The mean improvement for ODI at 1 year FU was at Norway 18, Sweden 17 and Denmark 18. The conclusion was, while the indications for decompression were similar, there were significant differences for concomitant arthrodesis.

But the additional arthrodesis was not associated with better results.

-In support of the same conclusion a multicenter study by Rachid Bech-Azeddine et al 2019 (20) with 2737 patients, underwent sole decompression and followed for 12 months, they had a significant reduction on Low Back and Leg pain (Baseline for LBP 72,1 to 42.1 and Leg pain 71,2 to 41,3. (VAS, ODI, EuroQoL-5D)

In a near opposite opinion, a recent study C.Wang(2020) (21) supporting fusion in severe Lumbar Stenosis (Central and Lateral) where to achieve a satisfactory decompression a wide laminectomy and facetectomy >75% was needed. In order to prevent a post-op instability, fusion was added in 153 pa-

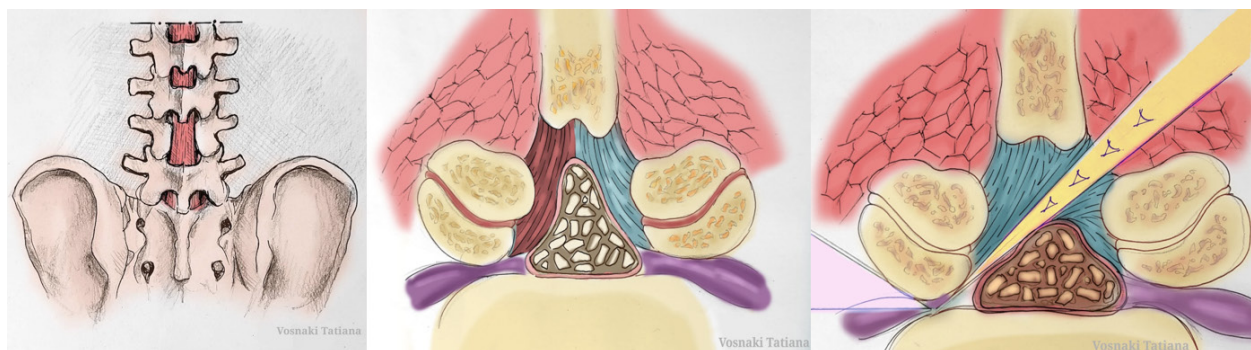


Fig. 8. *Conventional Laminectomy vs Unilateral Laminotomy Over the Top*

tients. Postero-lateral in 77 (PLF) or PLF+Interbody in 76. Both groups achieved significant improvement (JOA,VAS ODI) and high fusion rates in both, making interbody fusion not necessary.

In an attempt to identify, why almost a quarter of patients are not satisfied after a decompressive surgery for LSS, a recent study Yoji Ogura 2020 (22) found that smoking status and scoliosis with mild curve, were associated with dissatisfaction. This conclusion may help surgeons in decision making, by adding fusion even with mild scoliosis.

There is a question that comes out. Is it possible to have any beneficial effect in LBP by decompression alone for spinal stenosis w/o instability. To this question tried to give an answer a study from Canada 2019 (23) where participated 50 Neuro and Ortho Hospitals (Academic and no Academic) with 1221 patients (1133 had data on LBP) 85% followed at 3 months and 73% at 24 months. All operated for stable Spinal Stenosis (w/o Degenerative Scoliosis or Spondylolisthesis). 72% underwent Decompression alone and Decompression plus Fusion 26%. At 3 months the improvement was 74% and 68% at 2 years. At 12 months the improvement was greater in decompression alone. The addition of fusion did not impact the improvement in LBP.

Interspinous Spacers

A lot has been written about interspinous Spacers, concerning, Indications ,Effectiveness and presumable complications. Main indication, the moderate Spinal Stenosis.

As far as effectiveness in midterm treatment at least comparable with open decompression. Many

Authors support, that leg pain, the primary complain decreased by 70% during 2 years FU, whereas after laminectomy by 43-69% Jacola 2010 Strom-qvist 2013 (24)....

In a recent RCT study by Vicas Patel et al Spine 2015, (25) 391 patients randomly divided in two groups: Superior 190 and X-Stop 201. Spinous process fracture was the main complication (non healed at two years) largely asymptomatic with no influence on clinical effectiveness of either device.

In an other multicenter RCT study by Meyer and JC.Le Huec 2016 (26) with 163 patients from 19 hospitals sites and 10 countries comparing Interspinous spacers and standard decompression. The results for leg pain (VAS) improved 59% with spacers and 66% for Standard Decompression Surgery (SDS) at 12 months FU.

As far as SF-36, it was equal in both groups.

By equally achieved satisfactory results, opens a window for patients with neurogenic claudication and other comorbidities.

Multisegmental Spinal Stenosis.

The challenge of multisegmental spinal stenosis (MSSS) is whether we can proceed with selective or multisegmental Decompression plus Fusion. (Fig.10)

The choice is based mainly on clinical symptoms and how many Levels should be decompressed and if there is a concomitant Scoliosis or Spondylolisthesis.

Otherwise we can choose the more stenotic level for decompression

In a paper by We Sun at al 2019 (27) they operated

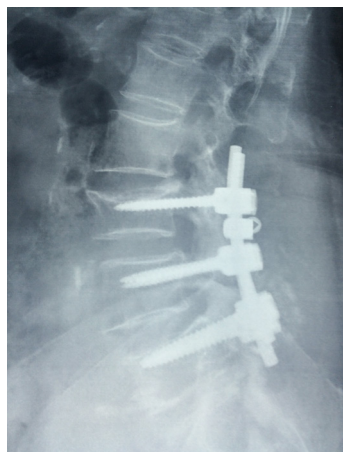


Fig.9 Sole decompression vs Decompression plus Fusion



Fig.10 Multisegmental stenosis

on 42 patients with MSSS.

In 22 they did selective decompression plus fusion (mainly Deg.Spondylolisthesis) and in 20 multisegmental decompression plus fusion. Their conclusion was that Selective decompression and fusion is safe and effective for the treatment of MSSS, with advantages of shorter operative time, less blood loss and preservation of spinal motion segments.

In multisegmental fusion you have to think of presumable complications as adjacent segment disease, implant failures (rod and screw fractures or screw displacement) and where to stop in the upper levels (Fig .11)

Spinal Stenosis and Degenerative Scoliosis

Many elderly patients have spinal stenosis with concomitant Degenerative Scoliosis mild to severe. The Spine Surgeon faces with the dilemma to proceed to simple Decompression according to symptoms or to Decompression plus Fusion.

Given the elderly patients with LSS and Degenerative Scoliosis often have comorbidities, the question that arises, is Surgery safe and effective? Can Decompression alone alleviate LBP? If we choose to add fusion this should be Short or Long? Can we identify predictors of post-op LBP?

As far as Fusion, Short or Long, the decision making should be based in some parameters. The degree of Scoliosis, the location of apical vertebra and sagittal parameters. In a recent paper by Li Y.2020 (28,29) comparing the effectiveness of Short versus Long fusion

for DS with a Cobb Angle 20-40* operated on 50 patients. Long Fusion Group (>3 segments) 23 patients and Short Fusion Group (<3 segments) 27 patients. Their conclusion was that long fusion has more advantages in enhancing spinopelvic parameters (Cobb angle, SVA,LL,PT,SS) and relieving LBP by choosing appropriate fixation levels. (Fig 12) On the other hand Short fusion had less surgical trauma and fewer complications. Yuanqiang Li et al 2020) (29)

Spinal Stenosis and Degenerative Spondylolisthesis

Many patients with LSS have have concomitant degenerative spondylolisthesis. The symptoms of DS are more severe in comparison to simple spinal stenosis mainly due to the local spinal instability, the root entrapment and the accompanied sagittal imbalance.

Howard An and col 2020 (30), they did Dynamic X-Rays, Flexion-extension, registering translational and angular motion, spondylotic changes and lumbar lordosis.

MRI Scan was useful to determine the degree of disc degeneration.(Disc height, degree of slip and translation as well)

They found that in DS patients, the preserved Disc height was significantly related to dynamic instability. In contrast disc degeneration on MRI and spondylotic changes were inversely related to dynamic instability, representing a restabilization mechanism as described by Kirkaldy-Willis many years ago, decreasing the chance of future slip.

Surgical options include, decompression alone or

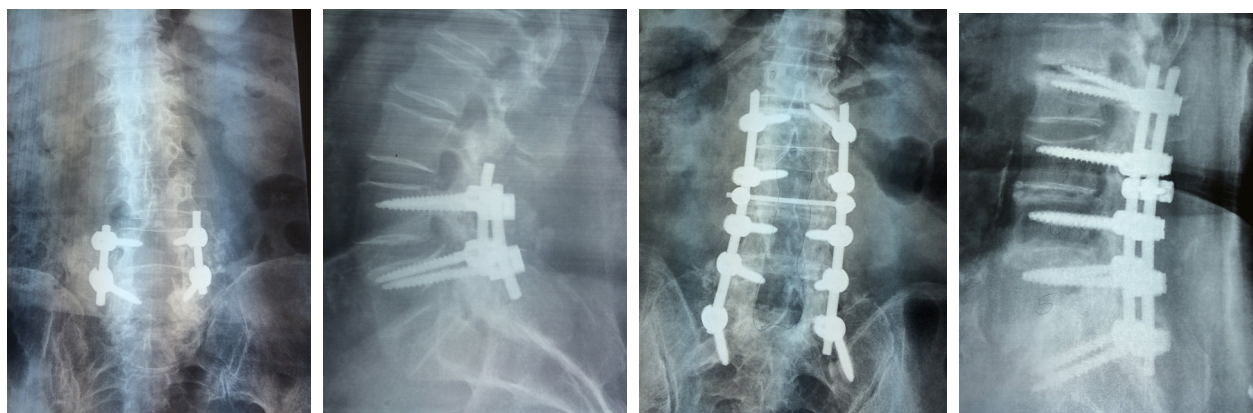


Fig.11. Selective and multi-segmental Decompression plus fusion

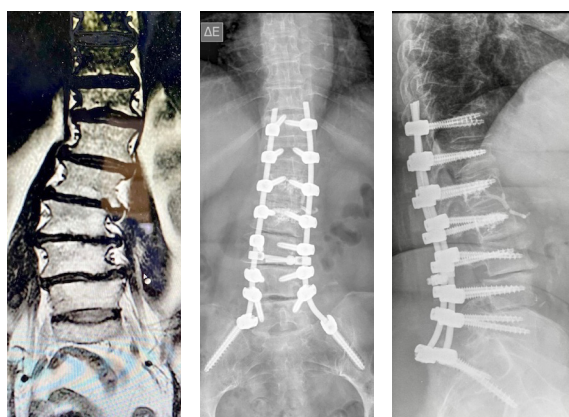


Fig. 12 Spinal Stenosis and Deg. Scoliosis



Fig. 13 DS.Decompression +PLF+TLIF

decompression plus fusion. Fusion is posterolateral (PLF) or PLF accompanied by Transforaminal Interbody (TLIF) or Posterior Interbody (PLIF) ALIF OR XLIF .

In conclusion the selection of surgical treatment method for Degenerative Spondylolisthesis relies in preoperative factors already mentioned, surgeons experience and discretion, and his familiarity with microsurgical and endoscopic methods. Fig.13

Lumbar Stenosis and Cauda Equina Syndrome

Cauda Equina Syndrome in Adults with Spinal Stenosis is a challenge to diagnose.

The Clinician has to be very suspicious and through directional questions to rule out symptoms related to Cauda Equina Syndrome (CES) This is because the symptoms are not so acute as in situations of CES by a massive Disc Herniation. (Acute onset, Increased Low

Back and radicular pain involving both limbs, saddle area paresthesia, gait dysfunction or paralysis and sphincter incontinence)

In spinal stenosis the symptoms are more insidious and the diagnosis more challenging. (High prevalence of retention, Irritation and obstructive symptoms)

Usually patients with LSS and Cauda Equina Syndrome have symptoms only from Urinary tract. The symptoms from the bladder are accompanied by radiculopathy or LBP (more noisy and painful) and are perceived by patients without clinical importance. (Geriatric incontinence)

A Clinician should be very suspicious and persisted to rule out, a neuropathic bladder, with urodynamic studies.

This is a growing clinical issue because of the escalating prevalence of LSS in ageing population.

The clinical presentation may be unclear and be-

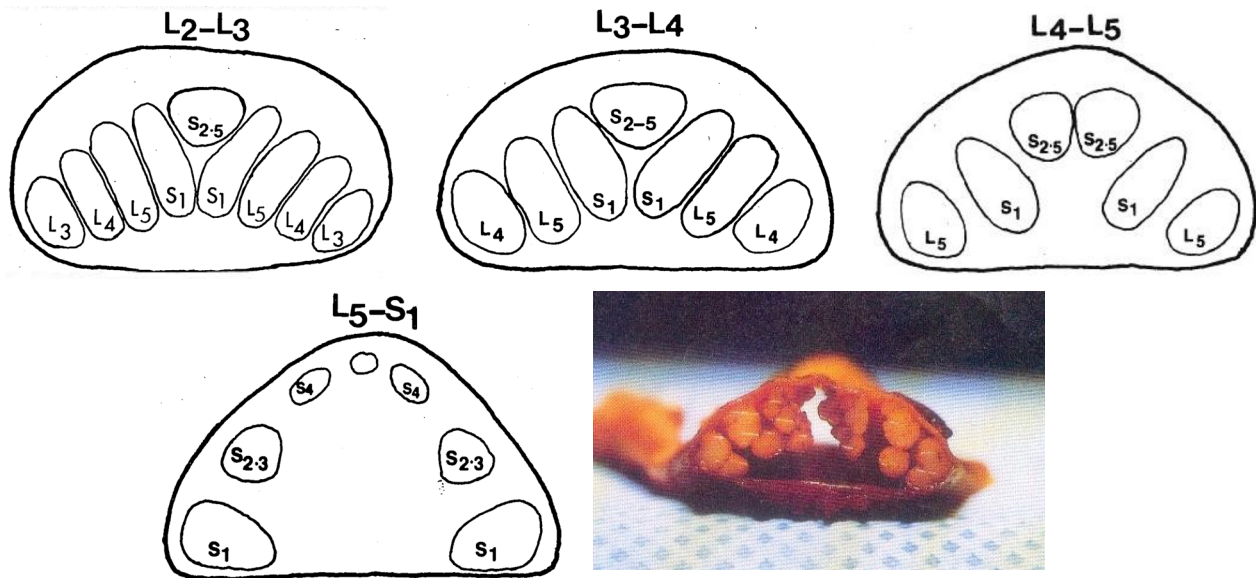


Fig14. Position of S2-S4 nerve roots in the Dural Sac in Spine Levels L2 to S2. Courtesy by Bjorn Rydevik ref 33

cause of the slow onset of the grumbling cauda equina symptoms may be overlooked or dismissed (Jacob Oh Asian Spine 2020 (31))

The patho-anatomical changes in lumbar Spinal Canal, especially those leading to the reduction of the AP diameter, are responsible for the onset of symptoms.

The thin sympathetic and parasympathetic nerve fibers to the bladder are highly vulnerable, both to the mechanical and Chemical affection. In a prospective study by Anders Perner et al Spine 1997, 55% of the patients had Lower Urinary Tract Symptoms. (32)

None of them had the typical Cauda Equina Syndrome. (Decreased perianal sensitivity and reflexes and anal sphincter tone)

In 1999 Biorg Rydevik (33) described the Cauda Equina Anatomy. In four levels, L2-L3, L3-L4, L4-L5 and L5-S1 the roots going to the bladder, occupy the middle of equina explaining, why they are more sensitive to the AP diameter reduction instead of the cross sectional area.

In a study by Yoshiro Inoui Spine 2004 (34) is described the relationship between dural sac antero-posterior diameter (AP) and the incidence of neuropathic bladder. They noted that the mean dural sac AP diameter in Normal was 8,26+- 2,3 mm and in patients with


Neuropathic Bladder (NB) 6,56+- 2,52 mm

Evaluating the critical size of AP diameter of dural Sac, noted that when the AP diameter was < 8mm, 82,4% of patients presented with Neuropathic bladder while with >8 mm AP, patients with NB were 35,3%. This implies the importance of AP diameter of dural sac more than the cross sectional area. Fig.14

Conclusions

The question was How and When should operate on in spinal stenosis patients

There are not clear answers.

- The operative treatment must be tailored to each patient.
- An old patient w/o signs of instability or severe deformity (typical Spinal Stenosis) can be benefited with sole decompression w/o instrumented fusion
- Patients age it is not a contraindication of Decompressive surgery
- Newer Surgical Techniques are a promising of less invasive surgery with optimal results 

Conflict of interest

The authors declare no conflicts of interest.

REFERENCES

1. Kalichman L, Cole R, Kim DH, Li L, Suri P, Guermazi A, Hunter DJ. Spinal stenosis prevalence and association with symptoms: the Framingham Study. *Spine J*. 2009 Jul;9(7):545-50.
2. Singh K, Samartzis D, Biyani A, An HS. Lumbar spinal stenosis. *J Am Acad Orthop Surg* 2008;16(3):171-6.. 3.Cheung JP, Samartzis D, Shigematsu H, et al Defining clinically relevant values for developmental spinal stenosis: a large-scale magnetic resonance imaging study. *Spine* 2014;39(13):1067-76. 4. Christy Tomkins-Lane, Markus Melloh, Jon Lurie et al. ISSLS Prize Winner:Consensus on the Clinical Diagnosis of Lumbar Spinal Stenosis. Results of an International Delphi Study. *Spine* vol 41 No 15 pp 1235-1246. 2016
5. Gen Inoue,Masayuki Miyagi,Masashi Takaso et al (2016) Surgical and nonsurgical treatment for Lumbar Spinal Stenosis. *Eur J Orthop Surg Traumatol* 2016 Oct 26: 695
6. Francisco Kovacs, Gerard Urrutia, Jose Alarcon. Surgery versus conservative treatment of symptomatic lumbar spinal stenosis:A systematic review of randomized controlled trials. *SPINE* Sep 15,2011 E1335-51
7. Zaina F, Tomkins-Lane C, Carragee E, Negrini S. Surgical Versus Nonsurgical Treatment for Lumbar Spinal Stenosis. *Cochrane collaboration Spine*. 2016 Jul 15;41(14):E857-68.
8. Clemens Weber,Charalambos Giannadakis ,Vidal Rao et al .Is there an association Between Radiological Severity of Lumbar Spinal Stenosis and Disability,Pain, or Surgical Outcome? A Multicenter Observational Study. *SPINE* 2016 jan 41 E78-83
9. Konstantine Shizas, Nicolas Theumann Alexandre Burn et al Qualitative grading of severity of lumbar spinal stenosis based on the morphology of the Dural sac on Magnetic Resonance Images 2010. Oct 1.35.pp 1919-24
10. Kanamori,H.Matsui,N.Hirano et al Trumpet Laminectomy for Lumbar Degenerative Spinal Stenosis. *J Spinal Disord* 1993 Jan 6.pp 232-7
11. Kleeman TJ,Hiscoe AC.Berg EE.Patient outcome after minimally destabilizing lumbar stenosis decompression.The 'Port-Hole' technique *SPINE* 2000 Apr 1 pp 865-70
12. Spetzger U, Bertalanffy H, Naujokat C, von Keyserlingk DG, Gilsbach JM. Unilateral laminotomy for bilateral decompression of lumbar spinal stenosis. Part I: anatomical and surgical considerations. *Acta Neurochir (Wien)*. 1997;139(5):392- 396. 4.
13. Sngbong Ko,and Taebum Oh.Comparison of bilateral decompression via unilateral laminotomy and conventional laminectomy for single-level degenerative lumbar spinal stenosis regarding low back pain functional outcome,and quality of life-A Randomized Controlled Prospective Trial *Journal of Orthopaedic surgery and Research* 2019 pp 1298-3
14. Fu YS et al Long term outcomes of two different decompression techniques for lumbar spinal stenosis. *Clinical Trial SPINE* 2008
15. Nils H.Ulrich,Jakob B. Burgstaller Giuseppe Pichlerri et al. Decompressive surgery alone versus decompression plus Fusion in symptomatic Lumbar Spinal Stenosis. A Swiss Prospective Multicenter Cohort Study with 3 years FU. *SPINE* 2017 Vol. 42 No 18 pp E1077-1086
16. Forsth P.Olafsson G.Carlsson T et al A Randomized Controlled Trial of fusion surgery for lumbar spinal stenosis. *Engl J Med* 2016 Apr 14 pp1413-23
17. Erik Y. TyeJosqua Anderson Arnold Haas et al. Decompression Versus Decompression and Fusion for Degenerative Lumbar Stenosis in a Workers' Compensation setting. *SPINE* 2017 Vol.42 No 13,pp 1017-1023
18. Rikke Rousing,Rikke Kruger Jensen,Soren Fruensgaard et al Danish National clinical guidelines for surgical and nonsurgical treatment of patients with lumbar spinal stenosis. *Eur Spine J* Jun 28 pp1386-1396
19. Greger Lonne, Peter Fritzell, Olle Hagg et al .Lumbar Spinal Stenosis: Comparison of Surgical Practice Variation and clinical outcome in three national spine registries. *The Spine Journal* 2019 (19) pp 41-49.
20. Rachid Bech-Azeddine,Soren Fruensgaard,Mikkel

- Andersen et al Outcomes of decompression without fusion in patients with lumbar spinal stenosis with back pain. Proceedings of the 34th Annual Meeting of the North American Spine Society / The Spine Journal 19 (2019) S101!S140
21. Chenxu Wang,Xiang Yin,Liang Zhang et al Posterolateral fusion combined with posterior decompression shows superiority in the treatment of severe lumbar spinal stenosis without lumbar disc protrusion or prolapse. A retrospective study Journal of Orthopaedic Surgery and research 2020
 22. Yoji Ogura, Yoshiomi Kobayashi,Yoshio Shinozaki et al Factors Influencing Patient Satisfaction after Decompressive Surgery without Fusion for Lumbar Spinal Stenosis .Global Spine Journal 2020, Vol. 10(5) 627-632.
 23. Shreya Srinivas,Jerome Paquet,Chris Bailey et al Effect of Spinal decompression on back pain in lumbar spinal stenosis:a Canadian Spine Outcomes Research Network. (CSORN) study The Spine Journal 2019 (19) PP 1001-1008
 24. Stromqvist BH,Berg S.Gerdhem P. et al.X-Stop versus decompressive surgery for lumbar neurogenic intermittent claudication: randomized controlled trial with 2-year follow-up.SPINE 2013 Aug 1.pp 1436-42
 25. Vikas Patel,Peter Whang,Thomas HaleySuperior Interspinous Process Spacer for intermittent Neurogenic Claudication secondary to moderate lumbar spinal stenosis.A randomized trial.SPINE 2015 VOL 40No 5 pp 275-282
 26. Bernard Meyer,Jean Charles Le Huec. A multicenter randomized controlled Clinical trial to evaluate the effectiveness and safety of a standalone percutaneous spacer versus decompressive surgery in degenerative lumbar spinal stenosis with neurogenic intermittent claudication. Global Spine Surgery 2016
 27. We Sun et al Selective versus multi-segmental decompression and fusion for multi-segment lumbar spinal stenosis with single-segment degenerative spondylolisthesis. J Orthop Surg Res 2019
 28. Bai H,LI Y,Liu C et al Surgical management of Degenerative Lumbar Scoliosis Associated with Spinal Stenosis:Does PI-LL Matter? SPINE 2020 Aug 1,pp 1047-1054
 29. Li Y, Ou Y, Zhu Y,He B, et al Effectiveness of short-segment fixation versus long-segment fixation for degenerative Scoliosis with cobb angle 20-40*. A retrospective observational study. Med Sci Monit 2020 Jul 22
 30. William Slikker, Alejjandro Espinosa, Howard An et al Based Markers predict Dynamic Instability in Lumbar Degenerative Spondylolisthesis. Neurospine 2020.17 pp 221-227
 31. Jacob YL Oh,Jun-Hao Tan,Timothy WW Teo et al Spinal stenosis presenting with scrotal and perianal claudication. ASIAN SPINE J. 2020 pp 103-105
 32. A.Perner,J.T.Andersen,M.Juh. Lower urinary tract symptoms in lumbar root compression syndromes:a prospective survey. SPINE 1997 Nov.15 (22) pp 2693-7
 33. E. J. Wall, M.S. Cohen, B.Rydevic et al Cauda equine anatomy.I:Intrathecal nerve root organization. SPINE 1990 Dec 15 (12) pp 1244-7

READY - MADE
CITATION

Patsiaouras T. Degenerative Lumbar Spinal Stenosis. When and How Should We Operate On. *Acta Orthop Trauma Hell* 2021; 72(1): 45-57.