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GUIDELINES

Degenerative Lumbar Spine Stenosis Consensus Conference: the Italian job. Recommendations of the Spinal Section of the Italian Society of Neurosurgery

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ABSTRACT

In the modern era evidence-based medicine, guidelines and recommendations represent a key-point of daily activity. The Spinal Section of the Italian Society of Neurosurgery introduced some recommendations regarding Degenerative Lumbar Spine Stenosis based on those of the Spine Committee of World Federation of Neurosurgical Societies, revising them on the basis of Italian common practice. In June 2019, a Committee of 21 spine surgeons met in Rome to validate the recommendations of the WFNS. Furthermore, they decided to review the ones that did not reach a consensus to create Italian Recommendations on Degenerative Lumbar Spine Stenosis. A literature review of the last ten years was performed and the statements were voted using the Delphi method. Forty-one statements were discussed, and 7 statements were voted again to reach a consensus with respect to those of the WFNS. A total of 40 statements reached a consensus, of which 36 reached a positive consensus and 4 a negative consensus, while no consensus was reached in 1 case. Conservative multimodal therapy, tailored on the patient, is a reasonable and effective first option choice for the treatment of LSS patients with tolerable moderate symptoms. Surgical treatment is reserved for symptomatic patients non-responding to conservative treatment or with neurological deficits. The best surgical technique to use depends on personal experience; modern MISS techniques are equivalent to open decompressive surgery with some advantages and higher cost-effectiveness. Fusion surgery and mobility preserving surgery only have a marginal role in the treatment of DLSS without instability.

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KEY WORDS: Lumbar vertebrae; Health planning guidelines; Guidelines.

Introduction

In the modern era evidence-based medicine, guidelines and recommendations represent a key-point of daily activity. In particular, these tools permit a clear indication for the epidemiology, diagnosis, treatment and cost-effectiveness of specific issues in medicine, as well as neurosurgery.

However, evidence-based findings are generated almost entirely in the Western World and the application of specific guidelines in national realities may be difficult, due to the clinical point of view and specific legislation. However, the scientific society has been working together over recent years to introduce the concept of global indications. To overcome drawbacks, the World Federation of Neurosurgical Societies (WFNS) has organized conferences and meetings with the aim of defining recommendations as a combination of evidence-based and expert-based suggestions to assist practitioners in their everyday practice worldwide. In particular, in the field of spine surgery, the WFNS Spine Committee instigated a survey on different topics with the aim of obtaining strong agreement or recommendations to address key clinical questions surrounding diagnosis and treatment, to assist surgeons in all countries affording daily spine pathologies.[1]

One of the topics analyzed recently has been lumbar spine stenosis: these recommendations are intended to reflect contemporary treatment concepts for symptomatic degenerative lumbar spinal stenosis (DLSS) as presented in the highest quality clinical literature and best clinical practices available on this subject, considering the different possibilities and facilities in countries worldwide.[1-6]

However, it should be noted that the importance of guidelines and/or recommendations is not only needed in daily activity, but also from a medical-legal point of view. That is why, the Italian Society of Neurosurgery (SINch) is trying to define national guidelines, and as a member of the WFNS this process starts from its official guidelines.

The aim of this paper is to present the recommendation for DLSS proposed by SINch.

Methodology

With the aim of standardizing the diagnosis and treatment of degenerative lumbar spine stenosis (DLSS) as much as possible, the World Federation of Neurosurgical Society (WFNS) held a Consensus Conference on this topic. A Committee of experts in spine pathology reviewed the literature of the last ten years and voted a series of statements regarding the natural history, diagnosis, conservative and surgical treatment of DLSS. These statements were published as recommendations to be available worldwide. Based on the results of this Consensus Conference, the members of the Spinal Section of the Italian Society of Neurosurgeon (SINch) carefully and critically analyzed the statements. According to criteria defined by the Spine Committee of WFNS, a literature review was performed including papers from a period span of 10 years (2008-2018) conducted using the Cochrane Database of Systematic Reviews and MEDLINE/PubMed. Among the identified articles, a secondary search of the listed citations was performed to ensure that all relevant publications were included.

The Delphi Method was applied to administer a questionnaire and obtain a consensus on various topics. This approach is frequently used in scientific and medical contexts with the aim of reaching a consensus among a group of experts when scientific evidence is lacking or conflicting. To establish a consensus, the levels of agreement or disagreement on each item were voted independently in a blind-manner using a Likert-type scale from 1 to 5 (1=strongly disagree, 2=disagree, 3=somewhat agree, 4=agree, 5=strongly agree). Results were expressed as a percentage of respondents who scored each item as 1 or 2 (disagreement) or as 3, 4 or 5 (agreement). Consensus was achieved when the sum for disagreement or agreement was ≥66%. Each consensus point was clearly defined with evidence strength, recommendation grade, and consensus level provided.[1]

Results

A consensus meeting was held in Rome in June 2019, the steering committee was composed of 21 neurosurgeons,

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experts in spinal pathologies and members of the Spine Section of the SINch. In this session they analyzed the 41 statements assessed and voted by the WFNS Spine Committee. In detail, the statements assessed for the specific argument were the following. Panel 1: 8 statements regarding natural history and diagnosis with both radiological imaging and electrophysiological tests. Panel 2: 8 statements regarding conservative and physical treatment, which kind of physical therapy is indicated and for how long. Panel 3: 6 statements regarding interventional treatment (pain relief techniques), which type of drugs to use and for how long to proceed before considering surgery. Panel 4: 10 statements regarding surgical treatment indications, which type of surgery and its complications. Panel 5: 7 statements about the presence of low back pain in adjunct to symptoms correlated to the LSS, definition of instability and indications for fusion surgery instead of only decompression surgery. Finally, Panel 6: 2 statements regarding adjacent segment disease and indications for dynamic fusion surgery.

Of those statements a total of 34 (82.93%) statements reached a consensus, of which 32 reached a positive consensus (94.11%) and 2 a negative consensus (5.88%), while in 7 cases (17.07%) no consensus was reached.

The Italian Committee accepted statements that reached a consensus, either positive or negative, and incorporated them into the Italian Recommendations. The seven statements that did not reach a consensus in the WFNS meeting are summarized in Table I. These statements were carefully reviewed and voted again based on the presented review of the literature and Italian common practice.

At the end of the voting session, the Italian Recommendations incorporated 41 statements of which 40 reached a consensus (97.56%): 36 positive consensus (90%) and 4 a negative consensus (10%), and 1 statement did not reach a consensus (2.43%).

In detail, the non-consensus statements of the WFNS regarded the following:

- effectiveness of percutaneous pain relief techniques in the treatment of LSS;[3]
- efficacy of the different surgical techniques for decompression and, in particular, minimally invasive techniques and their cost-effectiveness;[4]
- overall complication rate of surgical decompression, in particular personal experience differ from literature data;[4]
- indication to fusion surgery in case of DLSS.[5]

The two statements regarding the role and efficacy of percutaneous pain relief techniques were discussed together. The number of papers that looked specifically at facet joint injections in lumbar spine stenosis was limited. Two articles were identified with Class III evidence finding facet joint injections to be therapeutic in the management of lumbar spine stenosis. Most of the other studies looked at facet injections for management of lower back pain or diagnostic purposes. The Class I evidence FACTS study determined that facet block was not therapeutic but might provide prognostic value before radiofrequency ablation.[7, 8]

Cohen *et al.*[9] made a randomized controlled clinical trial (RCT) on 229 patients with low back pain and randomized 3 groups: intrarticular injection, medial branch nerve injection and intrarticular injection with placebo. They concluded that facet block is not therapeutic in the treatment of isolated low back pain. It can play a prognostic role before radiofrequency ablation of the medial branch of the nerve cause, patients that respond to injections will respond better to ablation. The long-term efficacy of these procedures is still under debate.

In their article, Manchikanti *et al.*[10] presented a systematic review and best evidence synthesis of effectiveness of therapeutic facet joint interventions: after accurate analysis, they found Level II evidence of effectiveness for radio frequency neurotomy and lumbar facet joint nerve blocks in lumbar spine pathologies.

The National Institute for Health and Care Excellence

TABLE I.—*List of the statements that were presented and voted during a consensus meeting of the Spine Section of the Italian Neurosurical Society. These statements were the ones that did not reach a consensus during the World Federation of Neurosurgical Societies Consensus Meeting on Degenerative Lumbar Spine Stenosis.*

S1	Facet Joint injections Provide Significant Pain Relief for treatment of Low Back Pain.
S2	When Facet Joint Injection is effective facet/ medial branch nerve ablation should be performed.
S3	Microscopic techniques are equal to standard laminectomy for achieving adequate spinal canal decompression.
S4	Unilateral laminotomy for bilateral decompression or bilateral laminotomy are not inferior to standard laminectomy for treatment of spinal stenosis.
S5	MIS is a more cost-effective technique than open laminectomy.
S6	Overall complication rate for lumbar decompressive surgery is approx. 20% and reoperation rates are almost 10% in 5 years.
S7	If the main complaint is mechanical axial low back pain, more than leg pain, this is suggestive for spondylolisthesis and the patient may benefit from a fusion surgery.

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guidelines (NICE) for managing low back pain (LBP) were recently updated and do not recommend intra-articular facet joint injections on the grounds of there being insufficient high-quality evidence to support their use, recommending targeting the nerve supply of the facet-joints instead as the predominant pain generator source.[11]

Based on the presented literature and personal experience the Committee voted as follows:

• statement 1: facet joint injections provide significant pain relief for treatment of low back pain. This statement reached a negative consensus with 80% of negative votes (10% voted grade 4 of Linkert Scale (LS), 10% voted grade 3, 35% voted grade 2 and 45% voted grade 1);

• statement 2: when facet joint injection is effective, facet/ medial branch nerve ablation should be performed. This statement reached a negative consensus with a percentage of 75% of negative votes (5% voted grade 4 of LS, 20% voted grade 3 of LS, 35% voted grade 2 of LS and 40% voted grade 1 of LS).

It was stated previously that surgical decompression has an effective role in the treatment of symptomatic degenerative lumbar spine stenosis, however, still under debate is the effectiveness of the different surgical techniques. The review of literature regarding this topic allows the conclusion that microscopic techniques represent an effective surgical treatment of LSS and are feasible in the majority of patients but there was insufficient evidence to support their superiority over standard laminectomy.[12-19]

Overdevest *et al.*[19] compared the effectiveness of novel microscopic techniques of posterior decompression with the comparison of 10 RCTs: microscopic techniques compared to conventional laminectomy analyzing functional disability, perceived recovery and leg pain, failed to show significant differences between the techniques. Proposed advantages of these techniques regarding the incidence of iatrogenic instability and postoperative back pain are plausible, but poor methodology and poor reporting of outcome measures in included studies limit definitive conclusions.

Costa *et al.* in a retrospective study of a consecutive series of 473 patients treated with unilateral microdecompression over a 5-year period defined that unilateral laminotomy to achieve bilateral decompression provides an adequate and safe decompression of the spinal canal in patients with LSS. Evaluation of the long-term follow-up data obtained showed very favorable results for overall clinical improvement and satisfaction, as well as a low rate of morbidity (no significant segmental instability requiring reoperation was shown), confirming the feasibility of this minimally invasive approach in elderly and younger patients alike.[20]

Phan and Mobbs, in their systematic review and meta-analysis, reached a similar conclusion. They compared classical open decompression to unilateral laminectomy for bilateral decompression and concluded that this microsurgical technique provides some advantages in terms of blood loss reduction, less disruption of muscular and ligamentous structures reducing pain and risk of instability and short hospitalization times. However, the evidence supporting that was of moderate quality and those findings warrant verification in large prospective registries and randomized trials.[21]

Ulrich *et al.*[22, 23] in a prospective multicenter cohort study published in 2019 analyzed the outcome of 277 patients operated on using unilateral or standard open midline approach for bilateral decompression in LSS; they did not find statistical differences between the two operative techniques and stated that both are effective treatment options to obtain adequate decompression in LSS. Similar results and conclusions are also present in research.

Based on the presented literature and personal experience the Committee voted as follows:

• statement 3: microscopic techniques are equal to standard laminectomy to achieve adequate spinal canal decompression. This statement reached a strong positive consensus with a percentage of 80% of positive votes (10% voted grade 5 of LS, 30% voted grade 4 of LS, 40% voted grade 3, 15% voted grade 2 and 5% voted grade 1);

• statement 4: unilateral laminotomy for bilateral decompression or bilateral laminotomy are not inferior to standard laminectomy for treatment of spinal stenosis. This statement reached a strong positive consensus with a percentage of 95% of positive votes (27% voted grade 5 of LS, 27% voted grade 4, 41% voted grade 3 and 5% voted grade 2).

While the statements regarding early clinical outcomes and lower incidence of complication rates of Minimally Invasive Spinal Surgery (MISS) techniques reached a strong positive consensus in the Consensus Conference of WFNS Spine Committee, the same results were not obtained regarding the cost-efficacy ratio of those techniques with respect to open laminectomy.

The analysis of studies regarding cost-effectiveness of minimally invasive decompression compared to open laminectomy found similar results at one-year and 2-year follow-up.[24-26]

In a recent review, Hopkins *et al.*[27] found increasing research interest over the last 5 years in defying the econom-

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ic value of MISS. However, there is a significant amount of heterogeneity in research quality and methodology and this limits the value of the results of those studies in defining the real economic value of MISS techniques and the possible higher cost-effectiveness with respect to standard open posterior approach.

Based on the presented literature and personal experience the Committee voted as follows:

• statement 5: MIS is a more cost-effective technique than open laminectomy. This statement reached a positive consensus with a percentage of 70% of positive votes (10% voted grade 5 of LS, 15% voted grade 4, 45% voted grade 3 and 30% voted grade 2).

Literature regarding complications of decompressive surgery for LSS is thriving and there are many reports. However, it is challenging to evaluate the overall complication rate because the value can vary greatly between different studies due to the heterogeneity of posterior spine surgery procedures analyzed, outcome and follow-up parameters.[4]

The unintended durotomy remains one of the most common complications in spine surgery. Ghobrial *et al.*[28] presented a 10-year systematic review of the literature; they selected 19 papers (7 prospective studies - level of evidence III; 12 retrospective studies - level of evidence IV) regarding open surgeries for a total of 15,965 patients. Six studies (2 prospective, 4 retrospective) for MISS decompression for a total of 1,334 patients and 5 comparative studies analyzing 1364 patients. The incidental durotomy was found respectively in 8.11% for open surgeries and 6.78% for MIS surgery, while the incidence for the comparative cohort was 7.20% versus 7.02% respectively.

Bernatz *et al.* gave an overview that was very close to the real incidence rate of complications in their review and meta-analysis. They evaluated the 30-day readmission rates in spine surgery: 13 articles were selected (5 studies were single center; 3 multicenter studies and 5 studies using national database) for a total of 48, 8049 patients included). Incidence of readmission after lumbar surgery was 4.6% of which 39.3% comprised non-infectious wound problems (dehiscence, hematoma, seroma), 28.2% infection (wound, sepsis), 4.5% dural tear and 26.6% medical complications (such as deep venous thrombosis and pulmonary embolism).[29]

Based on the presented literature and personal experience the Committee voted as follows:

• statement 6: overall complication rate for lumbar decompressive surgery is approximatively 20% and reoperation rates are estimated around 10% in 5 years. This statement did not reach a consensus; 65% expressed a positive vote but did not reach the limit of 66% to be significative (5% voted grade 5 of LS, 30% voted grade 4 of LS, 30% voted grade 3 of LS, 25% voted grade 2 of LS and 10% voted grade 1 of LS).

The last topic discussed was the role of fusion surgery in the case of association of degenerative LSS and back pain.

In an epidemiological study (Wakayama Spine Study), the authors found that spondylolisthesis is significantly associated with symptomatic LSS (Level of Evidence III) as the processes involving this degenerative pathology are multifactorial, leading to disruption of the anatomo-functional unit of the spine. However, at present, no unanimous criteria exist to identify what constitutes true instability.

Hence, whether fusion was performed for actual instability or not, remains controversial and the results, non-convincing.[30]

Shen *et al.*[31] performed a comprehensive meta-analysis that included the 5 most recent and cited RCTs to compare fusion with simple decompression, enrolling 438 patients. Pooled analysis showed no significant differences between decompression alone and fusion groups for the Oswestry Disability Index (ODI) scores at the baseline (P=0.50) and 2-year follow-up (P=0.71), and the satisfaction rate of operations was also similar for the groups (P=0.53).

Försth *et al.*[32] and Ghogawala *et al.*[33] made two important studies regarding the utility of fusion surgery in patients with LSS and, as clearly commented by Wilco *et al.*,[34] both trials showed that for most cases surgery should be limited to decompression when no overt instability is present (not confirmed on flexion–extension radiographs or MRI with signs suggestive for instability). The goal of surgery in lumbar spinal stenosis is to improve walking distance and to relieve pain by decompression of nerve roots. The addition of instrumented fusion, "just to be sure," for the treatment of the most frequent forms of lumbar spinal stenosis does not create any added value for patients and might be regarded as an overcautious and unnecessary treatment.[32-34]

Basing on the presented literature and personal experience the Committee voted as follows:

• statement 7: if the main complaint is mechanical axial Low Back Pain, more than leg pain, this is suggestive for spondylolistesis and the patient may benefit from a fusion surgery. This statement reached a positive consensus with a percentage of 70% of positive votes (10% voted grade 5 of LS, 15% voted grade 4, 45% voted grade 3 and 30% voted grade 2).

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Discussion

The definition of guidelines or recommendations is a complex process that must take many factors into consideration. The WFNS, in the field of neurosurgery, is trying very hard to overcome some of the limits in the process itself to provide a worldwide usable tool, such as the Consensus Conference, but the method chosen also presents some drawbacks. The WFNS Spine Committee reunites experts in spine pathologies from different parts of the world with different backgrounds, personal experience and skills in surgical techniques to discuss specific topics; on one hand, this represents a worldwide survey but on the other hand it constitutes a bias of the process itself. While epidemiology, natural history and diagnostic protocols of a certain pathology are accepted almost worldwide, in the absence of high-level literature therapeutic arguments are more subject to personal consideration based on specific experience and available technology.

In fact, an analysis of the statements that did not reach a consensus during the WFNS process shows they all regarded the treatment of DLSS. In particular, two of them were about the role of Facet Joint Injections in conservative treatment; and five were related to surgical techniques. In the first case it was due to the lack of high-level literature, while in the second it was for the lack of standardized criteria to compare the high-level literature present.

To discuss the treatment of DLSS primarily, it is essential to define the meaning of the term "mild spinal stenosis." Many different classifications have been proposed, based on MRI characteristics, clinical symptoms or ligament hypertrophy.[35-37]

The model proposed by Azimi *et al.*[38] constitutes an interesting synthesis of various parameters: SPWT, MRI findings (grade and SR) and Hufschmidt grade. A more relevant role, to define a stenosis severity grade, has been assigned to clinical symptoms; indeed, in the majority of cases, there are poor correlations between severity of spinal stenosis radiographically and the clinical presentation, which should guide medical practice and treatment decisions. According to this, "mild spinal stenosis" is a condition characterized by mild symptoms that is intermittent claudication. This clinical scenario is conditioned by a favorable natural history of the disease. In a study conducted by Wessberg *et al.*,[39] 50% of the patients with mild/moderate LSS, not eligible for surgical treatment due to tolerable symptoms, remained unchanged during a follow-up period of 3 years; moreover, one third of the patients reported an improvement in pain and walking ability during the same period. Moreover, Zweig *et al.*[40] affirmed that conservative treatment could be done safely and that the duration of preoperative therapy was not associated with the ultimate outcome of a secondary decompression surgery.[38-40]

Nowadays, the conservative options for mild DLSS patients are pharmacological treatment, bracing and physical therapy. Medical management consisted of nonsteroidal anti-inflammatory medications (NSAIDs), anticonvulsants, antidepressants for neuropathic pain, and opioids. Neuropathic pain medications can be helpful in improving the standing and walking intolerance for patients with mild symptomatic LSS. However, as reported in the recent Minimally Invasive Spine Treatment Guidelines, there is low quality evidence for using NSAIDS, neuropathic pain medications, and opioids as monotherapy.[41]

Lumbar supports, belts and corsets are commonly used for the management of low back pain. Many studies evaluated the effectiveness of lumbar orthotics for neurogenic claudication, showing a mild improvement on walking ability. It is known that lumbar orthosis reduces abnormal movements of the lumbar spine and this may add a mechanical support while walking, giving some advantage to the patients. However, lumbar orthotics reduces the axial loading and compromises muscular strength, causing discomfort in the long-term. Hence, their use is not recommended in the recent treatment guidelines published by the American College of Physicians.[42-46]

Physical therapy has always been considered an excellent option for conservative treatment of LSS in patients with mild symptoms or not eligible for surgery. Fritz *et al.*[47] analyzed the associations between physical therapy and long-term outcomes for individuals with lumbar spinal stenosis, using data collected from the SPORT study, enrolling a total of 654 patients. Authors asserted that physical therapy, within the first 6 weeks, was associated with greater improvement in physical functioning and reduced likelihood of surgery across a 1-year follow-up period.[15, 47]

Furthermore, Ammendolia *et al.*[48] compared different methods of physical training programs and demonstrated that a comprehensive conservative program can provide significant improvement in walking ability and can be a safe nonsurgical treatment option for patients with neurogenic claudication due to LSS. In a recent randomized trial, the clinical effects of medical therapy and different types of physical exercises have been evaluated: these approaches seem to be a reasonable option for patients with LSS who choose not to undergo surgery for tolerable symptoms. It is also possible that various combinations of

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these interventions might have a synergistic effect. This strategy is confirmed by the American College of Physicians recommendations for patients with chronic low back pain: clinicians should initially select nonpharmacologic treatment with physical therapy, tailored on patients' abilities.[46-49]

The role of Percutaneus Pain Relief Techniques and, in particular, the role of Facet Joint Injection is still highly debated. It seems to have a role in the treatment of chronic low back pain but literature about its employment in the treatment of DLSS is very poor. Furthermore, as explained by Fornari *et al.*[3] in their presentation of WFNS recommendations, the participants attending the consensus meeting of Spine Committee were for the most part surgeons who do not usually adopt conservative non-pharmacologic approaches for symptomatic LSS. This might have conditioned the vote, with a natural trend to increasing the importance of surgery versus the conservative approach.

In the Italian Consensus Conference, the two statements regarding percutaneous pain relief techniques were voted and reached a negative consensus. The steering committee was not able to find a clear role in the treatment in DLSS based on literature review. The studies analyzed suggest that facet joint injections, as well as epidural injections, provide some short to intermediate-term pain relief, and their role may be as palliative therapies for those patients (*i.e.* compromised patients, elderly patients, etc.) that are not eligible for surgery.

Regarding these techniques, the role of decompressive surgery in symptomatic patients (mild to severe symptoms) with DLSS is well stated in literature and clear recommendations were made. However, analyzing papers up to today, it is still difficult to define which is the best surgical approach to obtain decompression.

Surgery is generally considered the gold standard therapy for symptomatic DLSS, with several possible options, according to patients' pathology characteristics. Nevertheless, surgery can lead to side-effects, primarily spinal instability, that necessitate further operative treatment (frequently spinal fusion): indeed, the rate of reoperation is approximately 17%. Minimally invasive techniques such as insertion of interspinous/interlaminar spacers have shown a high rate of revision: about 27% of patients undergoing a second surgery during the first postoperative year. Moreover, about 22% of patients who underwent lumbar surgery were unsatisfied at the 1-year follow-up.[12, 50, 51]

In the papers of WFNS recommendations, some statements on this topic failed to obtain a consensus, especially those regarding minimally invasive techniques. For this reason, their final suggestion was to use the technique each surgeon is more confident with based on personal experience and surgical skills.

On the contrary, the analysis of the Italian Committee of the same statements based on the same literature review found a positive consensus with strong agreement. This can be explained by the fact that similar background, experience and technology can play an essential role in establishing the best clinical practice on one topic but make it ligated to the country of origin and this constitutes one of the bias of the process.

To choose which is the best surgical approach with its related complications is a crucial point, especially nowadays when the legal point of view is progressively increasing in daily clinical practice. The progressive increase of the overall rate incidence of complications can be related to the higher age of the treated population and higher incidence of more difficult cases. However, definitions of intraoperative, perioperative and postoperative complications have not been established and previous reports have varied in the definition of, and focus on, intraoperative or major postoperative complications. However, the complications rate reported (dural tears among 10% and an overall complication rate of 20%) sound too high, also in Italian Society, and do not represent the real incidence of complications in daily practice. The statements regarding this topic did not reach consensus in the WFNS Consensus Meeting or in the Italian Consensus; the committee agreed that further high-level studies are necessary to identify a more realistic rate of complications to allow the scientific society to define the incidence of complications correlated with specific surgical techniques.

Finally, the role of fusion surgery in treatment of DLSS is a much-debated point. The present trend is to limit the fixation technique where possible, and the committee agreed completely on this tendency. However, it must be considered that the weak point is in defying the presence of instability. In case of symptoms suggesting the presence of an instable lysthesis it is advisable to study this aspect in detail as patients may benefit from a fusion surgery.

Conclusions

All of this brought the steering committee to the conclusion that a conservative multimodal therapy, tailored on the patient, is a reasonable and effective first option choice for the treatment of patients with LSS with tolerable moderate symptoms. Surgical treatment is reserved for patients with a long history of symptoms resistant to conservative

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TABLE II.—*Recommendations for Degenerative Lumbar Spine Stenosis by Spinal Committee of WFNS and Spinal Section of Italian Society of Neurosurgery (SINch).*

Recommendations	WFNS	SINch
Natural Course and Diagnosis		
Approximately 30% of patients with lumbar spinal stenosis (LSS) are expected to worsen, but 30% may improve with conservative measures	✓	✓
There are predictive sign/symptoms that they will worsen:	✓	✓
Dural sac cross-sectional area <50 mm2		
Presence of radicular symptoms and back pain		
Presence of degenerative spondylolisthesis and/or scoliosis		
Illness duration >1 year		
MRI is the most appropriate noninvasive test for the diagnosis of LSS and the second is CT scan. CT myelography is appropriate if MRI is contraindicated or inconclusive	✓	✓
There is no correlation between clinical symptoms or function with the presence of anatomic narrowing of the spinal canal on MRI, CT or myelo-CT	✓	✓
Qualitative radiologic criteria describe adequately spinal stenosis in central, lateral or foraminal stenosis	✓	✓
There are some radiological signs that describe instability.	✓	✓
Direct signs on functional radiograms		
Indirect signs on MRI and CT such as Modic changes, end plate edema, extended discal vacuum, traction spurs, synovial cysts, annular tears, spondylolisthesis, "facet fluid sign"		
Routine electrophysiological tests (EMG, nerve conduction study, F-wave response, H-reflex, SEP, MEP) have no diagnostic value for LSS	✓	✓
Electrophysiological tests do not predict outcome of patients with LSS	✓	✓
Conservative Treatment and Follow-up		
If the clinical condition is not severe, a conservative approach based on at least 3 weeks of therapeutic exercise may be the first therapeutic choice	✓	✓
Medical/interventional treatment should be preferred to surgical treatment in spinal stenosis with mild symptoms	✓	✓
Physical therapy should consist of multimodal approaches	✓	✓
There is insufficient evidence to make a recommendation for the use of other physical therapy interventions (aquatic therapy, acupuncture, psychosocial intervention, transcutaneous tibial nerve stimulation, neural mobilization)	✓	✓
If conservative treatment is chosen, surgery should be considered, in case the clinical condition does not change in 3 months	✓	✓
There are no factors that can advise for a conservative treatment and which type	✓	✓
There are some cases in which an immediate surgical treatment should be indicated	✓	✓
There is no evidence that 3 or more months of conservative treatment should be applied before surgery	✓	✓
Percutaneous Pain Relief Techniques		
Facet joint injections provide a useful diagnostic tool for low back pain	nc	×
Facet Joint injections do not provide significant pain relief for treatment of Low Back Pain	✓	✓
When Facet Joint Injection is effective, facet/ medial branch nerve ablation should be performed	nc	×
The literature supports a short- to intermediate-term benefits of the epidural injections for the symptomatic treatment of LSS	✓	✓
The inclusion of steroids does not seem to confer a benefit compared to local anesthetic alone in epidural injections for the symptomatic treatment of LSS	✓	✓
For patients with symptomatic relief of less than 3 months after epidural injections, proceeding with further injections is not recommended	✓	✓
Decompressive Surgery		
Surgical decompression is an effective option in patients with moderate to severe symptoms	✓	✓
Microscopic techniques are equal to standard laminectomy for achieving adequate spinal canal decompression	nc	✓
Unilateral laminotomy for bilateral decompression or bilateral laminotomy are not inferior to standard laminectomy for treatment of spinal stenosis	nc	✓
Minimally invasive surgery (MIS) has some advantages over open decompression for early clinical outcomes (blood losses, wound pain and hospital stay)	✓	✓
MIS is associated with lower complication rates than open approach	✓	✓
MIS is a more cost-effective technique than open laminectomy	nc	✓
Overall complication rate for lumbar decompressive surgery is approximatively 20% and reoperation rates are estimated around 10% in 5 years	nc	nc
Cardiopulmonary complications and stroke in this elderly population occur in about 2% and mortality is 0.5%	✓	✓
New neurologic injury and postoperative hematoma after decompressive surgery are rare (≈1%)	✓	✓
Incidental durotomy is common (almost 10%) and depends on established risk factors and has only a minor effect on outcome	✓	✓
Fusion surgery		
In patients with DLSS and no sign or symptoms of instability and predominant leg pain, decompression alone is recommended	✓	✓
In patients with stenosis and stable spondylolistesis, fusion is not mandatory and decompression alone is suggested	✓	✓
Unstable spondylolisthesis with symptoms may require fusion	✓	✓
If the main complaint is mechanical axial low back pain, more than legs pain, this is suggestive for spondylolisthesis and the patient may benefit from a fusion surgery	nc	✓
Patients with LSS and loss of sagittal balance, if symptomatic, may benefit from decompression, fixation and deformity correction surgery	✓	✓
In patients, who underwent bilateral facetectomy more than 50% and bilateral discectomy, fusion may be advisable	✓	✓
Facet joint effusion alone is not proven to correlate with stability	✓	✓
Mobility Preserving Surgeries		
Decompression is the basis of surgical treatment of LSS	✓	✓
Fusion is an option especially when spondylolisthesis or instability are present, but indications remain controversial	✓	✓
Adjacent Segment Disease (ASD) incidence reports display high variability. It may be rare with single level fusion or in patients with minimal degenerative disease.	✓	✓
Floating L4-L5 fusion		
Poor sagittal balance		
Multilevel fusion may be associated with more ASD		
Dynamic fixation constructs are treatment options that may help to prevent ASD		

✓ Positive consensus; ×negative consensus; nc: non consensus

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treatment (up to 3 months) or patients with neurological deficits. The best surgical technique to use depends on personal experience with the techniques itself; modern MISS techniques are equal in efficacy to open decompressive surgery with the advantage of minor anatomical structure disruption (less postoperative pain and faster recovery) and higher cost-effectiveness. Fusion surgery and mobility preserving surgery only have a marginal role in the treatment of DLSS without instability.

All of the recommendations and suggestions of the SINch Spine Committee for Degenerative Lumbar Spine Stenosis are summarized in Table II.

References

1. Costa F, Anania CD, Zileli M, Servadei F, Fornari M. Lumbar Spinal Stenosis: Introduction to the World Federation of Neurosurgical Societies (WFNS) Spine Committee Recommendations. World Neurosurg X 2020;7:100075.

2. Zileli M, Crostelli M, Grimaldi M, Mazza O, Anania C, Fornari M, *et al.* Natural Course and Diagnosis of Lumbar Spinal Stenosis: WFNS Spine Committee Recommendations. World Neurosurg X 2020;7:100073.

3. Fornari M, Robertson SC, Pereira P, Zileli M, Anania CD, Ferreira A, *et al.* Conservative Treatment and Percutaneous Pain Relief Techniques in Patients with Lumbar Spinal Stenosis: WFNS Spine Committee Recommendations. World Neurosurg X 2020;7:100079.

4. Costa F, Alves OL, Anania CD, Zileli M, Fornari M. Decompressive Surgery for Lumbar Spinal Stenosis: WFNS Spine Committee Recommendations. World Neurosurg X 2020;7:100076.

5. Sharif S, Shaikh Y, Bajamal AH, Costa F, Zileli M. Fusion Surgery for Lumbar Spinal Stenosis: WFNS Spine Committee Recommendations. World Neurosurg X 2020;7:100077.

6. Roitberg B, Zileli M, Sharif S, Anania C, Fornari M, Costa F. Mobility-Preserving Surgery for Lumbar Spinal Stenosis: WFNS Spine Committee Recommendations. World Neurosurg X 2020;7:100078.

7. Park CJ, Shin YD, Lim SW, Bae YM. The effect of facet joint injection on lumbar spinal stenosis with radiculopathy. Pak J Med Sci 2018;34:968–73.

8. Shim E, Lee JW, Lee E, Im T, Kang Y, Ahn JM, *et al.* Facet joint injection versus epidural steroid injection for lumbar spinal stenosis: intra-individual study. Clin Radiol 2017;72:96.e7–14.

9. Cohen SP, Doshi TL, Constantinescu OC, Zhao Z, Kurihara C, Larkin TM, *et al.* Effectiveness of Lumbar Facet Joint Blocks and Predictive Value before Radiofrequency Denervation: The Facet Treatment Study (FACTS), a Randomized, Controlled Clinical Trial. Anesthesiology 2018;129:517–35.

10. Manchikanti L, Kaye AD, Boswell MV, Bakshi S, Gharibo CG, Grami V, *et al.* A Systematic Review and Best Evidence Synthesis of the Effectiveness of Therapeutic Facet Joint Interventions in Managing Chronic Spinal Pain. Pain Physician 2015;18:E535–82.

11. National Institute for Health and Care Excellence (NICE). Low Back Pain and Sciatica in Over 16s: Assessment and Management. NICE guideline (NG59). London: NICE; 2016.

12. Deyo RA, Martin BI, Kreuter W, Jarvik JG, Angier H, Mirza SK. Revision surgery following operations for lumbar stenosis. J Bone Joint Surg Am 2011;93:1979–86.

13. Zaina F, Tomkins-Lane C, Carragee E, Negrini S. Surgical versus non-surgical treatment for lumbar spinal stenosis. Cochrane Database Syst Rev 2016;(1):CD010264.

14. Thomé C, Börm W, Meyer F. Degenerative lumbar spinal stenosis: current strategies in diagnosis and treatment. Dtsch Arztebl Int 2008;105:373–9.

15. Weinstein JN, Tosteson TD, Lurie JD, Tosteson AN, Blood E, Hanscom B, *et al.*; SPORT Investigators. Surgical versus nonsurgical therapy for lumbar spinal stenosis. N Engl J Med 2008;358:794–810.

16. Watters WC 3rd, Baisden J, Gilbert TJ, Kreiner S, Resnick DK, Bono CM, *et al.*; North American Spine Society. Degenerative lumbar spinal stenosis: an evidence-based clinical guideline for the diagnosis and treatment of degenerative lumbar spinal stenosis. Spine J 2008;8:305–10.

17. Kreiner DS, Shaffer WO, Baisden JL, Gilbert TJ, Summers JT, Toton JF, *et al.*; North American Spine Society. An evidence-based clinical guideline for the diagnosis and treatment of degenerative lumbar spinal stenosis (update). Spine J 2013;13:734–43.

18. Diagnosis and treatment of degenerative lumbar spinal stenosis; 2011 [Internet]. Available from: https://www.spine.org/Research-Clinical-Care/Quality-Improvement/Clinical-Guidelines [cited 2021, Feb 17].

19. Overdevest G, Vleggeert-Lankamp C, Jacobs W, Thomé C, Gunzburg R, Peul W. Effectiveness of posterior decompression techniques compared with conventional laminectomy for lumbar stenosis. Eur Spine J 2015;24:2244–63.

20. Costa F, Sassi M, Cardia A, Ortolina A, De Santis A, Luccarell G, *et al.* Degenerative lumbar spinal stenosis: analysis of results in a series of 374 patients treated with unilateral laminotomy for bilateral microdecompression. J Neurosurg Spine 2007;7:579–86.

21. Phan K, Mobbs RJ. Minimally Invasive Versus Open Laminectomy for Lumbar Stenosis: A Systematic Review and Meta-Analysis. Spine 2016;41:E91–100.

22. Ang CL, Phak-Boon Tow B, Fook S, Guo CM, Chen JL, Yue WM, *et al.* Minimally invasive compared with open lumbar laminotomy: no functional benefits at 6 or 24 months after surgery. Spine J 2015;15:1705–12.

23. Mobbs RJ, Li J, Sivabalan P, Raley D, Rao PJ. Outcomes after decompressive laminectomy for lumbar spinal stenosis: comparison between minimally invasive unilateral laminectomy for bilateral decompression and open laminectomy: clinical article. J Neurosurg Spine 2014;21:179–86.

24. Nerland US, Jakola AS, Solheim O, Weber C, Rao V, Lønne G, *et al.* Minimally invasive decompression versus open laminectomy for central stenosis of the lumbar spine: pragmatic comparative effectiveness study. BMJ 2015;350:h1603.

25. Epstein NE. More nerve root injuries occur with minimally invasive lumbar surgery: let's tell someone. Surg Neurol Int 2016;7:S96–101.

26. Parker SL, Adogwa O, Davis BJ, Fulchiero E, Aaronson O, Cheng J, *et al.* Cost-utility analysis of minimally invasive versus open multilevel hemilaminectomy for lumbar stenosis. J Spinal Disord Tech 2013;26:42–7.

27. Hopkins B, Mazmudar A, Kesavabhotla K, Patel AA. Economic Value in Minimally Invasive Spine Surgery. Curr Rev Musculoskelet Med 2019;300–4.

28. Ghobrial GM, Theofanis T, Darden BV, Arnold P, Fehlings MG, Harrop JS. Unintended durotomy in lumbar degenerative spinal surgery: a 10-year systematic review of the literature. Neurosurg Focus 2015;39:E8.

29. Bernatz JT, Tueting JL, Anderson PA. Thirty-day readmission rates in orthopedics: a systematic review and meta-analysis. PLoS One 2015;10:e0123593.

30. Ishimoto Y, Yoshimura N, Muraki S, Yamada H, Nagata K, Hashizume H, *et al.* Association of Lumbar Spondylolisthesis With Low Back Pain and Symptomatic Lumbar Spinal Stenosis in a Population-based Cohort: The Wakayama Spine Study. Spine 2017;42:E666–71.

31. Shen J, Xu S, Xu S, Ye S, Hao J. Fusion or Not for Degenerative Lumbar Spinal Stenosis: A Meta-Analysis and Systematic Review. Pain Physician 2018;21:1–8.

32. Försth P, Ólafsson G, Carlsson T, Frost A, Borgström F, Fritzell P, *et al.* A randomized, controlled trial of fusion surgery for lumbar spinal stenosis. N Engl J Med 2016;374:1413–23.

33. Ghogawala Z, Dziura J, Butler WE, Dai F, Terrin N, Magge SN, *et al.*

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Laminectomy plus fusion versus laminectomy alone for lumbar spondylolisthesis. N Engl J Med 2016;374:1424–34.

34. Peul WC, Moojen WA. Fusion for Lumbar Spinal Stenosis—Safeguard or Superfluous Surgical Implant? N Engl J Med 2016;374:1478–9.

35. Lee GY, Lee JW, Choi HS, Oh KJ, Kang HS. A new grading system of lumbar central canal stenosis on MRI: an easy and reliable method. Skeletal Radiol 2011;40:1033–9.

36. Genevay S, Courvoisier DS, Konstantinou K, Kovacs FM, Marty M, Rainville J, *et al.* Clinical classification criteria for neurogenic claudication caused by lumbar spinal stenosis. The N-CLASS criteria. Spine J 2018;18:941–7.

37. Sakai Y, Ito S, Hida T, Ito K, Harada A, Watanabe K. Clinical outcome of lumbar spinal stenosis based on new classification according to hypertrophied ligamentum flavum. J Orthop Sci 2017;22:27–33.

38. Azimi P, Mohammadi HR, Benzel EC, Shahzadi S, Azhari S. Lumbar Spinal Canal Stenosis Classification Criteria: A New Tool. Asian Spine J 2015;9:399–406.

39. Wessberg P, Frennered K. Central lumbar spinal stenosis: natural history of non-surgical patients. Eur Spine J 2017;26:2536–42.

40. Zweig T, Enke J, Mannion AF, Sobottke R, Melloh M, Freeman BJ, *et al.*; Spine Tango Contributors. Is the duration of pre-operative conservative treatment associated with the clinical outcome following surgical decompression for lumbar spinal stenosis? A study based on the Spine Tango Registry. Eur Spine J 2017;26:488–500.

41. Deer TR, Grider JS, Pope JE, Falowski S, Lamer TJ, Calodney A, *et al.* The MIST Guidelines: The Lumbar Spinal Stenosis Consensus Group Guidelines for Minimally Invasive Spine Treatment. Pain Pract 2019;19:250–74.

42. Prateepavanich P, Thanapipatsiri S, Santisatisakul P, Somshevita P, Charoensak T. The effectiveness of lumbosacral corset in symptomatic degenerative lumbar spinal stenosis. J Med Assoc Thai 2001;84:572–6.

43. Weiss HR, Dallmayer R. Brace treatment of spinal claudication in an adult with lumbar scoliosis—a case report. Stud Health Technol Inform 2006;123:586–9.

44. Ammendolia C, Rampersaud YR, Southerst D, Ahmed A, Schneider M, Hawker G, *et al.* Effect of a prototype lumbar spinal stenosis belt versus a lumbar support on walking capacity in lumbar spinal stenosis: a randomized controlled trial. Spine J 2019;19:386–94.

45. van Poppel MN, de Looze MP, Koes BW, Smid T, Bouter LM. Mechanisms of action of lumbar supports: a systematic review. Spine 2000;25:2103–13.

46. Qaseem A, Wilt TJ, McLean RM, Forciea MA; Clinical Guidelines Committee of the American College of Physicians. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. Ann Intern Med 2017;166:514–30.

47. Fritz JM, Lurie JD, Zhao W, Whitman JM, Delitto A, Brennan GP, *et al.* Associations between physical therapy and long-term outcomes for individuals with lumbar spinal stenosis in the SPORT study. Spine J 2014;14:1611–21.

48. Ammendolia C, Côté P, Southerst D, Schneider M, Budgell B, Bombardier C, *et al.* Comprehensive Nonsurgical Treatment Versus Self-directed Care to Improve Walking Ability in Lumbar Spinal Stenosis: A Randomized Trial. Arch Phys Med Rehabil 2018;99:2408–2419.e2.

49. Schneider MJ, Ammendolia C, Murphy DR, Glick RM, Hile E, Tudorascu DL, *et al.* Comparative Clinical Effectiveness of Nonsurgical Treatment Methods in Patients With Lumbar Spinal Stenosis: A Randomized Clinical Trial. JAMA Netw Open 2019;2:e186828.

50. Sobottke R, Röllinghoff M, Siewe J, Schlegel U, Yagdiran A, Spangenberg M, *et al.* Clinical outcomes and quality of life 1 year after open microsurgical decompression or implantation of an interspinous standalone spacer. Minim Invasive Neurosurg 2010;53:179–83.

51. Macki M, Alvi MA, Kerezoudis P, Xiao S, Schultz L, Bazydlo M, *et al.*; MSSIC Investigators. Predictors of patient dissatisfaction at 1 and 2 years after lumbar surgery. J Neurosurg Spine 2019:1–10.

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