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To fuse or not to fuse: a survey among members of the German Spine Society (DWG) regarding lumbar degenerative spondylolisthesis and spinal stenosis

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Abstract

Introduction Surgical treatment methods for degenerative spondylolisthesis (decompression versus decompression and fusion) have been critically debated. The medical care situation is almost unknown for either treatment. Therefore, the aim of the present study was to provide information regarding the use of parameters for decision-making and the employment of surgical techniques.

Materials and methods A web-based survey was performed among members of the German-Spine-Society (DWG). Information regarding participant characteristics (specialty, age, DWG certification status, number of spine surgeries performed at the participant's institution each year, institutional status), estimates of the use of both treatment options, clinical and morphological decision-making criteria for additive fusion, and the surgical technique used was queried.

Results 305 members (45% neurosurgeons/ 55% orthopedic or trauma surgeons) participated in the present study. The participants estimated that in 41.7% of the cases, decompression only was required, while 55.6% would benefit from additional fusion. Among the participants, 74% reported that low back pain was an important indicator of the need for fusion if the numerical rating scale for back pain was at least 6/10. The most commonly used decompression technique was minimally invasive unilateral laminotomy, whereas open approach-based interbody fusion with transpedicular fixation and laminotomy was the most frequently used fusion technique. Specialty, age, certification status, and institutional status had a partial effect on the responses regarding indications, treatment and surgical technique.

Conclusions The present survey depicts the diversity of approaches to surgery for degenerative spondylolistheses in Germany. Considerable differences in treatment selection were observed in relation to the participants' educational level and specialty.

Keywords Degenerative spondylolisthesis · Fusion · Decompression · Indication · Surgical technique · Survey

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Introduction

Degenerative spondylolisthesis often leads to clinical symptoms such as neurogenic claudication and low back pain. At least since the SPORT trial, it has been well accepted that despite the success of multimodal therapeutical approaches [1], the outcomes of surgical treatment are superior to those of a conservative approach [2, 3]. Nevertheless, there is an ongoing debate regarding the best surgical procedure in terms of decompression versus decompression and fusion. Recently, von Försth et al. published a randomized prospective clinical trial showing no differences in clinical outcome and revision surgeries between the two procedures [4]. The results of that study were in favor of the use of decompression only. However, that study had some relevant methodological issues that reduced its clinical impact: (a)

well-accepted morphological criteria for segmental instability (e.g., segmental motion/slippage in extension/flexion radiographs, facet joint effusion on MRI) were not regarded; (b) different fusion (uninstrumented, posterior only, interbody fusion) and decompression (mostly central laminectomy, 18% bilateral laminotomy) techniques were used, and their distribution within the groups was somewhat unclear; and (c) the rate of one- and two-level surgeries was not reported for each group. These morphological and surgical technique-related parameters have been demonstrated to influence the outcome of fusion and/or decompression surgeries [5–9]. Therefore, the large standard deviations in the outcome parameters may reflect the problems regarding inclusion criteria and the lack of homogeneity in the surgical techniques used. In contrast, another study with a stricter definition of inclusion and methodology found that decompression with fusion had a superior outcome [10]. However, again, the surgical techniques used in that study may not reflect those most frequently employed in practice.

Then again, these variations within studies might reflect the real-life situation, in which different indications for decompression only or decompression with fusion are determined, and very different surgical techniques are employed to perform these procedures. Today, the actual medical care situation in terms of this noted lack of homogeneity remains unclear. Moreover, almost nothing is known about the influence of individual or institutional factors, such as the surgeon's specialty, age or qualifications or the hospital's educational status on the selection of a treatment option or technique. This information would be very useful for designing future studies to examine the most frequently performed surgical techniques, address clinically used inclusion criteria and possibly reach a consensus regarding a standard treatment. Therefore, the aim of the present study was to describe the medical care situation in terms of the institutional, individual/educational, and morphological factors that influence decision-making and the details regarding surgical technique based on a web-based survey among members of one of the largest spine societies in Europe.

Methods

From March to May 2017, a voluntary, anonymous, web-based survey was performed among e-mail-registered members of the German Spine Society (DWG). All registered members received an e-mail with a link to the survey, which could only be used once. The survey included questions about participant-specific parameters, estimates of the use of both treatment options, clinical and morphological decision-making criteria for additive fusion, and the surgical technique used. All the questions had to be answered to complete the online survey, and only complete datasets were used for analysis. The survey was completely anonymous regarding the participants' names and institutions.

Participant-specific parameters

The participants were asked to name their specialty and choose between neurosurgery and orthopedic or trauma surgery. The participants' ages were categorized into five groups: ≤ 30 years; 31–40 years; 41–50 years; 51–60 years; and > 60 years. Additionally, they were asked to provide their qualification in terms of DWG certifications (None, Base, Master, or Excellence). Additionally, the participants were asked to report on two institutional parameters: the number of spinal surgeries performed at the institution each year (< 100; < 300; < 600; ≥ 600) and the institution's status (university hospital; academic teaching hospital; private practice; other).

Treatment options

All the participants were asked to estimate the rates (in percentages) of decompression-only surgery and decompression with fusion surgery among the patients who underwent surgery for lumbar degenerative spondylolisthesis with spinal stenosis at their institution.

Clinical and morphological decision-making criteria for additive fusion

According to previously published risk factors for radiological or clinical failure of decompression-only treatment, the participants were asked whether back pain, patient age, or the following morphological parameters play a role in their decision to perform a fusion procedure (yes/no) [10–15]: segmental hypermobility (e.g., in flexion–extension radiographs), disc height, facet joint orientation, facet joint effusion, neuroforaminal stenosis at the index segment, disc herniation at the index segment, ligamentary stenosis, bony stenosis, rotational slippage, or lamina inclination angle. If they reported that back pain plays a role in their decision-making process, they were asked to indicate the minimal pain level using a numerical rating scale (NRS) of 1–10 (10 = maximum pain).

Surgical technique used

To determine differences in technical details, the participants were asked to indicate the procedure they used for most of the patients undergoing decompression only and decompression with fusion surgery. The possible technical parameters determining the surgical technique used for decompression-only procedures were (yes/no): minimally invasive approach, open approach, laminectomy, laminotomy, unilateral

decompression, and bilateral decompression. Decompression and fusion techniques were further defined according to the following parameters (yes/no): uninstrumented fusion, transpedicular stabilization, interbody fusion, percutaneous stabilization, open approach-based stabilization, laminectomy and laminotomy.

Statistical analysis

The data were descriptively analyzed using software (IBM SPSS Statistics V.24, IBM Corporation, Armonk, USA and GraphPad Prism V.5, GraphPad Software, Inc., La Jolla, USA) and with Fisher's exact test for categorical parameters and the Mann–Whitney *U* test/Kruskal–Wallis test and post hoc Dunn's test for continuous variables. The level of significance was set to $p = 0.05$.

Results

Participant-specific data/characteristics

Of the contacted members of the German Spine Society, 305 successfully completed the survey. Regarding specialty, 44.9% were neurosurgeons, and 55.1% were orthopedic/trauma surgeons. Most of the participants were 41–50 years old (44.3%); the rest constituted the following age groups, listed in order of size: 31–40 years (25.6%), 51–60 years (24.6%), above 60 years (4.6%) and below 31 years (1%). The neurosurgeons (age groups < 31/31–40/41–50/51–60/> 60 years: 1.5/19/41.6/33.6/4.4%, respectively) were older ($p = 0.06$) than the orthopedic/trauma surgeons (age groups < 31/31–40/41–50/51–60/> 60 years: 0.6/31/46.4/17.3/4.8%, respectively). Most of the participants did not have a DWG certificate (39.7%). Approximately one-third had Master certification (35.4%), 15.7% had Base certification, and 1.3% had Excellence certification; 7.9% were not willing to report their certification status. No difference ($p = 0.56$) could be found between the neurosurgeons and orthopedic/trauma surgeons regarding certification.

Most of the participants worked at an academic teaching hospital (47.9%); however, 16.7% reported working at a university hospital, 16.4% were private practitioners, and 19% worked at non-classified institutions/hospitals. The neurosurgeons were more likely to work at university hospitals and private practices (university 21.2%; academic teaching hospital 35.8%; private practice 27.7%; non-classified 15.3%), whereas the orthopedic/trauma surgeons more often worked at academic teaching hospitals (13.1/57.7/7.1/22%, respectively; $p < 0.001$). At most institutions, ≥ 600 spine surgeries were performed per year (43.9%), followed by < 600 (28.2%), < 300 (23.6%), and < 100 (4.3%). The neurosurgeons worked at institutions that performed a higher number of spine surgeries per year (< 100/<300/<600/≥600: 0.7/21.2/28.5/49.6%, respectively) more often than the orthopedic/trauma surgeons did (7.1/25.6/28/39.3% respectively; $p = 0.016$).

Treatment options

The participants estimated that approximately 41.7 ± 27.4% (mean ± standard deviation) of all surgically treated degenerative spondylolisthesis underwent decompression only, whereas 55.6 ± 27.3% required additional fusion. The rates differed significantly according to the surgeon's specialty ($p_{decompression} < 0.001$; $p_{fusion} < 0.001$, Fig. 1), certification level ($p_{decompression} = 0.001$; $p_{fusion} < 0.001$, Fig. 2), and educational status of the surgeon's institution ($p_{decompression} = 0.002$; $p_{fusion} = 0.012$, Fig. 3). The results of post hoc tests are shown in the figures. The rates were not significantly different among the different participant age groups ($p_{decompression} = 0.776$; $p_{fusion} = 0.793$) or the number of spine surgeries performed per year at the institution ($p_{decompression} = 0.953$; $p_{fusion} = 0.539$).

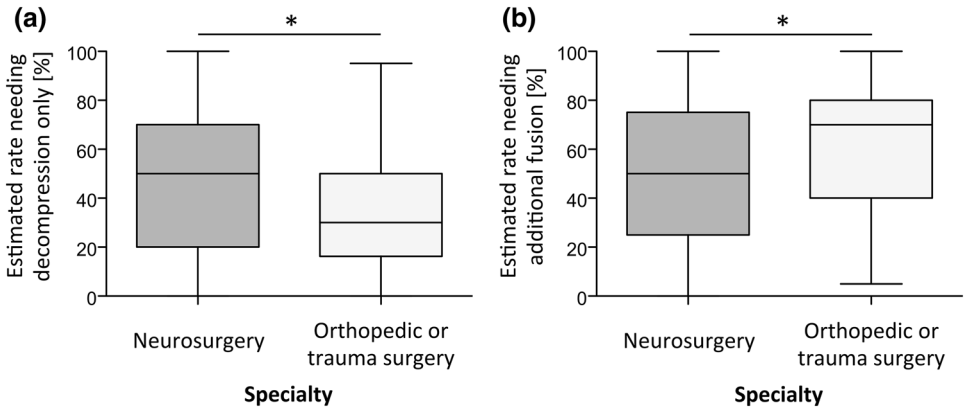

Fig. 1 The figure shows the proportions of patients with lumbar degenerative spondylolisthesis needing **a** decompression only and **b** decompression and fusion, separated by specialty, as estimated by the survey's participants. *Significance determined with the Mann–Whitney *U* test ($p < 0.05$)

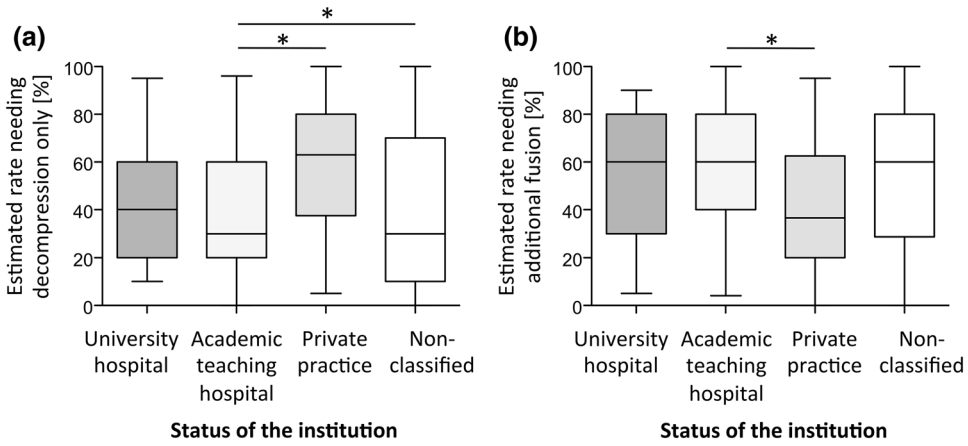

Fig. 2 The figure shows the proportions of patients with lumbar degenerative spondylolisthesis needing **a** decompression only and **b** decompression and fusion, separated by institutional status, as estimated by the survey's participants. *Significance based on the post hoc Dunn's test ($p < 0.05$)

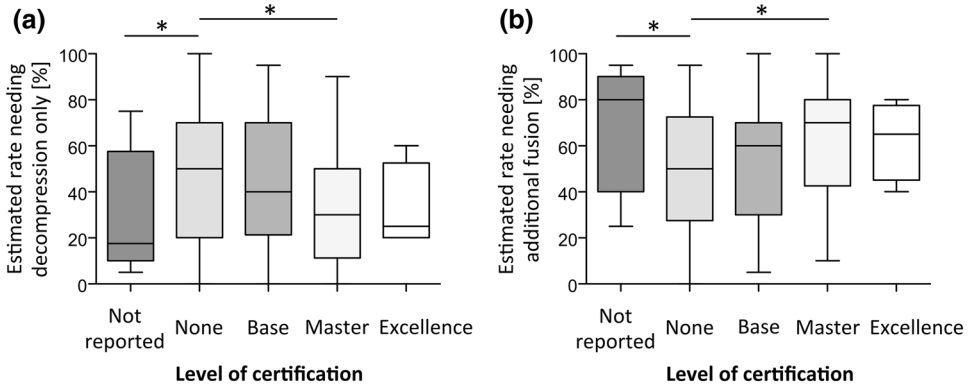

Fig. 3 The figure shows the proportions of patients with lumbar degenerative spondylolisthesis needing **a** decompression only and **b** decompression and fusion, separated by participant certification level, as estimated by the survey's participants. *Significance based on the post hoc Dunn's test ($p < 0.05$)

Clinical decision-making criteria for an additive fusion

A proportion of 74.4% of the participants reported that back pain is relevant to the decision to perform an additional fusion. The mean level of back pain that had to be reported to be a relevant factor in decision-making was an NRS of 6 ± 1.2 of 10. Only the surgeon's age group (< 31/31–40/41–50/51–60/> 60 years: 33.3/87.2/74.1/69.3/42.9%, respectively; $p = 0.001$) and the institution's status (university hospital 92.2%; academic teaching hospital 74.7%; private practice 68%; non-classified 63.8%; $p = 0.002$) played a role in recognizing back pain as relevant factor for fusion. Irrespective of the surgeon's specialty, age or certification level or the number of surgeries performed per year at the institution, 76.1% of the participants listed the patient's age as a parameter that influences the decision not to perform an additional fusion. Only the institution's status influenced whether the patient's age was a consideration (university hospital 82.4%; academic teaching hospital 79.5%; private practice 78%; non-classified 60.3%; $p = 0.026$).

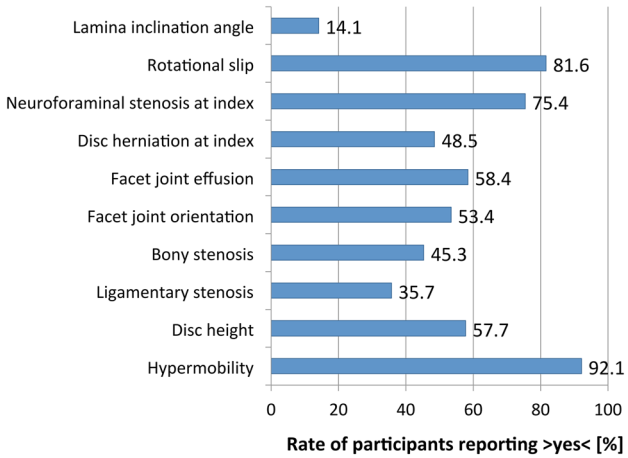

Fig. 4 The figure shows the proportion of the participants that indicated that morphological parameters presented are important for the decision to use fusion

Morphological decision-making criteria for an additive fusion

The different morphologic parameters considered in the decision to perform fusion are presented in Fig. 4. Table 1

Table 1 Significant differences in the judgement of the relevance of morphologic parameters for fusion decision-making according to participant characteristics

Morphologic parameters	Hypermobility present	Disc height	Neuroforaminal stenosis at index segment	Ligamentary stenosis	Bony stenosis	Rotational slip present
Participant age group in years						
< 31	66.7%	33.3%				
31–40	96.2%	69.2%				
41–50	93.3%	58.5%				
51–60	90.7%	42.7%				
> 60	71.4%	71.4%				
p value*	0.017	0.008	ns	ns	ns	ns
Specialty						
Orthopedic or trauma surgery		69.1%	81.0%	41.1%	53.6%	86.3%
Neurosurgery		43.8%	68.6%	29.2%	35.0%	75.9%
p value*	ns	< 0.001	0.016	0.041	0.002	0.025
Academic status of the hospital						
University hospital		64.7%				
Academic teaching hospital		61.0%				
Private practice		36.0%				
Non-classified		62.1%				
p value*	ns	0.009	ns	ns	ns	ns
Level of certification						
Base			81.3%			70.8%
Master			82.4%			88.0%
Excellence			100.0%			75.0%
None			66.1%			76.9%
Not reported			75.0%			100.0%
p value*	ns	ns	0.036	ns	ns	0.003

ns not significant

**p* values are based on Fisher's exact test

indicates significant differences according to the participants' characteristics.

Technical aspects of decompression/fusion

The reported rates of the techniques used for most of patients undergoing decompression only or decompression and fusion are presented in Figs. 5 and 6. Significant differences according to the participant characteristics can be found in Tables 2 and 3.

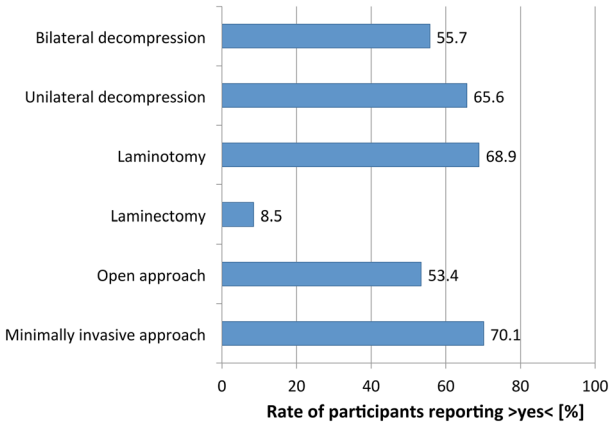

Fig. 5 The figure presents the proportion of participants that indicated that the technical aspects presented reflect the procedure they use for most patients undergoing decompression only

Discussion

To the authors' knowledge, this study is the first attempt to describe the local spectrum of treatment for degenerative spondylolisthesis with spinal stenosis in Germany. Although most of the surgeons worked in large, experienced spine units with an academic teaching focus, the rates of additional fusion surgery, the criteria for deciding to perform fusion

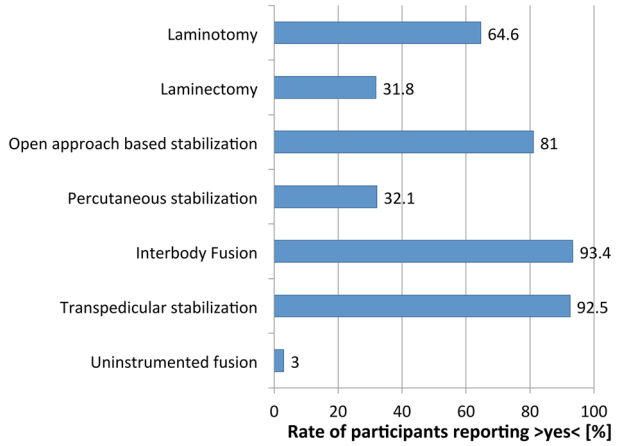

Fig. 6 The figure presents the proportion of participants that indicated that the technical aspects presented reflect the procedure they use for most patients undergoing decompression and fusion

surgery, and the techniques used showed considerable variance throughout the country.

Despite recently published data regarding the success of decompression only in degenerative spondylolisthesis cases [4, 11–13] and its frequent discussion at consecutive meetings, the participants reported performing spinal fusion more often. Nevertheless, compared with clinical data from the USA [14], the rates reported for decompression only were rather high. Interestingly and in contrast with an international survey [15], higher institutional academic status and higher surgeon certification level further affected the decision to perform fusion. It is possible that increased knowledge regarding the different criteria that can be an indicator of segmental instability [16, 17] drives the surgeons to perform more fusions. Alternatively, it is possible that private practitioners see fewer complications from biomechanically failed decompression surgeries than surgeons who work in larger hospitals, to which even private practices refer problematic or revision cases. However, also monetary reasons might influence the choice of treatment in different settings.

Clinically, most of the participants in this study indicated that back pain with an NRS of 6/10 was a relevant parameter indicating the need for spinal fusion, even though many studies have reported the effects of decompression alone on axial back pain [4, 11–13]. Back pain itself is often interpreted as a clinical symptom of segmental instability [18, 19]; however, the results of these studies suggest that spinal stenosis itself can cause back pain, which can be relieved by decompression only. A recent meta-analysis on decompression versus fusion in spinal stenosis patients also suggests that low back pain can be resolved without additional fusion [20]. Finally, the positive effect of fusion on back pain remains unclear [21–23]. (Postsurgical) Instability can also be a factor that adds to back pain and results in the need for fusion surgery in a subcohort [12, 24–26]. However, the proportion

Table 2 Significant differences in the rates of decompression-only techniques according to participant characteristics

Technical aspect	Minimally invasive approach	Open approach	Laminectomy	Laminotomy	Unilateral decompression
Participant age group in years					
< 31			33.3%		
31–40			10.3%		
41–50			6.7%		
51–60			5.6%		
> 60			40.0%		
p value*	n.s	n.s	0.030	n.s	n.s
Specialty					
Orthopedic or trauma surgery	77.4%	44.1%		73.8%	56.6%
Neurosurgery	61.3%	65.0%		62.8%	76.6%
p value*	0.003	< 0.001	n.s	0.047	< 0.001
Level of certification					
Base			4.2%		70.8%
Master			4.6%		63.0%
Excellence			0.0%		75.0%
None			10.7%		71.1%
Not reported			33.3%		37.5%
p value*	n.s	n.s	0.025	n.s	0.027

ns not significant

**p* values are based on Fisher's exact test

Table 3 Significant differences in the use of decompression and fusion techniques according to participant characteristics

Technical aspect	Percutaneous stabilization	Open approach-based stabilization	Laminectomy	Laminotomy
Specialty				
Orthopedic or trauma surgery	22.0%	88.1%		70.8%
Neurosurgery	44.5%	72.3%		56.9%
p value*	< 0.001	0.001	n.s	0.016
Academic status of the hospital				
University hospital			50.1%	43.1%
Academic teaching hospital			32.2%	69.2%
Private practice			28.0%	64.0%
Non-classified			17.2%	72.4%
p value*	ns	ns	0.002	0.005

ns not significant

**p* values are based on Fisher's exact test

of such patients may differ among groups undergoing different decompression techniques and presenting different radiological signs of instability [11, 12, 24, 27]. Interestingly, in a previous survey among members of the Lumbar Spine Research Society and the AOSpine in 2015 regarding the treatment of degenerative spondylolisthesis, the absence of segmental motion in flexion–extension radiographs, the absence of low back pain and advanced age (also rated as important in the present survey) had the largest impact on the surgeon's decision not to perform fusion [15]. For such an ideal patient, approximately 53% of the survey's participants determined that decompression only would be the best kind of treatment [15]. However, only 2.5% of the surgeons in every circumstance recommended isolated decompression for a patient with degenerative spondylolisthesis in this study. Almost nothing is known regarding the real clinical rates of fusion surgery in patients with degenerative spondylolisthesis in Germany. In 2011, Kepler et al. showed that based on the American Board of Orthopedic Surgery database, approximately 96% of the patients with degenerative spondylolisthesis were fused [14], which is in contrast to the reported rates of both the present survey and that conducted by Schroeder et al. [15]. There may be different reasons for this gap between survey responses and clinical reality, such as a higher percentage of patients fulfilling the fusion criteria (lower age, more patients with instability), higher reimbursement for fusion procedures, or keeping with traditional surgical algorithms.

Many morphological parameters that may be associated with a less favorable outcome in patients who undergo decompression only have been described; these include motion/hypermobility, larger disc height, a facet angle > 50°, and facet joint effusion on MRI [16, 17, 24, 25]. The presence of the first three parameters in one patient seems to lead to a 75% risk of reoperation when laminectomy without fusion is performed [17]. Other parameters have been reported to increase adjacent segment degeneration after fusion, such as facet tropism or an increased lamina inclination angle; these factors might influence the decision to perform an additional fusion [28]. The participants seemed to very differentially apply this knowledge in their daily work. The most frequently used parameter was hypermobility, followed by rotational slippage, neuroforaminal stenosis, facet effusion, and disc height. Similarly, in the international survey, segmental motion/instability was the most frequently cited morphological parameter, followed by grade of slip, facet effusion, and disc height [15]. Surprisingly, in the present survey, more orthopedic and trauma surgeons than neurosurgeons reported basing their decision to perform on morphological parameters, and the academic background of the institution and participant certification only played a minor role. The survey data showed variations in the surgical technique used for decompression only and decompression with fusion in Germany. However, the most frequently used decompression technique was minimally invasive unilateral laminotomy, while the most frequently used fusion technique was open approach-based interbody fusion with transpedicular fixation and laminotomy-based decompression. Both techniques might be more favorable in terms of reoperation and outcome than the techniques used in most high-level studies. Laminectomy has been demonstrated to be a risk factor for reoperation in decompression-only cases because it destabilizes the posterior structures and results in a higher rate of adjacent segment degeneration in fusion cases [8, 9, 16]. Furthermore, interbody fusion with transpedicular fixation was shown to result in less adjacent segment degeneration 10 years after fusion and in less pseudarthroses, which significantly affect the clinical outcome, even when the patient has not undergone surgical revision [5–7, 29]. However, there are conflicting results regarding the benefits of anterior support in fusion

surgeries; it is unclear whether it leads to a decrease in the reoperation rate because of less adjacent segment disease or improves clinical outcomes [30]. Possibly, especially the subgroup of unstable degenerative spondylolisthesis patients clinically benefits from interbody fusion [31]. Again, specialty influenced the technique that was used most frequently. Neurosurgeons more often used unilateral decompression via an open approach. Especially, the high rate of open approach-based surgery is somewhat surprising because minimally invasive decompression in cases with degenerative spondylolisthesis was shown to result in lower reoperation and spontaneous fusion rates, less slip progression, and greater patient satisfaction than open surgery [32]. Maybe most of them got trained with open approach and this result will change in the next generation of spinal (neuro)surgeons. During fusion surgeries, neurosurgeons seemed to perform more percutaneous transpedicular fixations, whereas the orthopedic and trauma surgeons more often used an open approach and laminotomies for decompression. Additionally, and surprisingly, laminectomies are performed more often than laminotomies at university hospitals than in other types of institutions. However, in the German context, a comparison of these commonly used techniques will have a much larger clinical impact than the high-level studies that have been previously published.

The present study is not without limitations. First, the study is a survey, and the surgeons' responses might not reflect the actual clinical data. Database or register analyses might better represent the clinical reality. Second, the study involved a subgroup of surgeons who are members of a science-based society, and many of these members undergo teaching courses, such as the German Spine Society's certification programs. Non-members may follow completely different treatment algorithms. Finally, the survey depicts a relatively local (German) situation which might be completely different to other countries or parts of the world.

In conclusion, the present survey depicts the actual spectrum of medical care regarding surgery for lumbar degenerative spondylolistheses with spinal stenosis in Germany. The survey showed that new prospective and randomized studies comparing the clinically most frequently employed techniques are needed to develop general treatment algorithms/guidelines. In contrast to a recent international survey [15], the participants' educational level and specialty influenced most of the answers. These results imply that in Germany, there is still considerable inhomogeneity in teaching the indication for the need for additional fusion and special surgical techniques. However, this might be the result of the ongoing controversy in the literature regarding the best treatment and traditional specialty-specific surgical algorithms.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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