

## TITLE PAGE

### Title

Postoperative bracing after lumbar surgery: a survey amongst spinal surgeons in Belgium

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## **Abstract**

**Purpose:** Bracing is frequently prescribed following lumbar surgery for degenerative conditions. However, previous studies failed to demonstrate advantage of postoperative lumbar bracing in both short and long term outcome in terms of pain, quality of life and fusion rate. The purpose of this study was to assess the prescription patterns and rationale for postoperative bracing among spinal surgeons in Belgium.

**Methods:** A 16-item online-survey was distributed by email to spinal surgeons affiliated to the Spine Society of Belgium (N= 252).

**Results:** A total of 105 surgeons (42%) completed the survey. The overall bracing frequency following lumbar surgery was 38%. A brace was more often prescribed following fusion procedures (52%) than after non-fusion procedures (21%) ( $p < 0.0001$ ). The majority of surgeons (59%) considered bracing after at least one type of lumbar surgery. Orthopaedic surgeons (73%) reported a significantly higher rate of prescribing postoperative bracing compared to neurosurgeons (44%) ( $p = 0.003$ ). Pain alleviation (67%) was the main goal for prescribing a postoperative brace. A total of 42% of the surgeons aimed to improve fusion rate by bracing after lumbar fusion procedures. A quasi-equal level of the scientific literature (29%), personal experience (35%) and teaching from peers (36%) was reported to contribute on the attitudes towards prescribing bracing.

**Conclusions:** Postoperative bracing was prescribed by Belgian spinal surgeons following more than one third of lumbar procedures. This was underpinned by beliefs regarding pain alleviation and higher fusion rate. Interestingly, based on the scientific literature these beliefs have been demonstrated to be false.

**Keywords** Orthosis · Postoperative Period · Practice Pattern · Spine · Low Back Pain

## **Introduction**

Internationally a rising trend is observed in the frequency of lumbar surgery for degenerative conditions [1]. Following lumbar surgery, a brace may be applied [2, 3]. However, the benefits of postoperative bracing remain controversial [2]. In addition there are potential disadvantages of postoperative bracing [2]. Besides the high expenses on braces for patients and our society, prolonged external immobilisation can lead to deterioration of the back muscles, skin irritation and discomfort [2, 4].

Spinal surgeons may prescribe a brace, based on different assumptions. Firstly, many believe that bracing results in higher fusion rate [2, 5]. In contrast to this believe, past literature showed no clear reduction of intervertebral motion nor reduced biomechanical loading upon the internal spinal fixation in response to bracing [6-8]. In addition, a randomized controlled trial has demonstrated an equivalent fusion and complication rate two years after surgery with postoperative bracing, compared to a control group without bracing [9]. Secondly, prescribing bracing also aims to improve quality of life and pain relief on short- as well as long-term follow-up, despite lack of evidence in past literature [[9]. Based on these findings, the indication and relevance for postoperative bracing is still unclear [2, 4, 9, 10]. In 2008, Bible et al [3] conducted a survey amongst spinal surgeons and demonstrated that the frequency of prescribing a brace following lumbar surgery is 49%. Additionally, the authors reported no consensus in terms of the indication, type and duration of bracing [3]. Recently, the American Association of Neurological Surgeons (AANS) did not recommend the use of a brace following lumbar fusion for degenerative conditions [10].

Therefore, the objectives of the present study were 1) to assess the current clinical practice of postoperative bracing following lumbar surgery in Belgium; and 2) to investigate the rationale of prescribing bracing following lumbar surgery in association with the type and duration.

## **Methods**

### **Subjects**

All spinal surgeons (N= 252) affiliated to the Spine Society of Belgium (SSBe), received an invitation by email to participate in this study. The SSBe is the largest spinal association in Belgium consisting of orthopaedic surgeons, neurosurgeons and specialists in Physical and Rehabilitation Medicine. The study was approved by the local Medical Ethics Committee UZ KU Leuven / Research (S60109) (ClinicalTrials.gov, Identifier NCT03427281). Consent of participation was considered by voluntary completing the questionnaire.

### **Materials and design**

An online survey was developed to assess surgeons' postoperative bracing practice (Appendix A). The content and design was driven by the input of our multi-disciplinary group of eight experienced clinicians and researchers: one neurosurgeon (BDP), two orthopaedic spine surgeons (LM, SS), three physiotherapists (TT, LJ, TS), a resident and graduated specialist in physical and rehabilitation medicine (LB, PVW). Based on a previous study by Bible et al. [3], the current survey comprised a total of 16 multiple choice questions, in English to access both French- and Dutch-speaking parts of Belgium. This cross-sectional study was reported according to the CHERRIES checklist for internet surveys [11], and the STROBE statement for cross-sectional studies [12].

#### *Type of lumbar surgery*

Surgeons were asked to identify the lumbar surgical procedures they currently perform: 1) lumbar discectomy, 2) lumbar laminectomy, 3) posterior lumbar fusion with instrumentation, 4) posterior fusion without instrumentation, 5) anterior lumbar interbody fusion (ALIF) with instrumentation, 6) ALIF without instrumentation, 7) transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF), 8) lumbar arthroplasty and/or 9) dynamic lumbar fixation.

#### *Frequency of bracing*

For each procedure performed, the frequency of postoperative bracing was asked (always, often, sometimes or never). If a brace was prescribed, surgeons needed to complete further questions regarding their prescription pattern and underlying rationale.

#### *Patterns of bracing*

The type of brace (lumbar corset, off the shelf lumbosacral orthosis, custom-moulded lumbosacral orthosis without or with pelvic immobilisation) and duration of bracing (< 3 weeks, 3-8 weeks, 2-4 months, > 4 months or case-dependent) were asked if a brace was prescribed.

#### *Rationale for bracing*

Surgeons who prescribed a brace were further questioned about the underlying rationale(s) for bracing (increase fusion rate, improve pain and/or slow down the patient) and the reason(s) determining the duration (fixed time period set before surgery, bone quality, age, pain, level of function and/or other). For each type of surgery, the participants indicated if they mainly based their decision to whether or not brace on scientific literature, personal experience or teaching from peers. Last, they were asked whether (and why) or not the number of spinal levels included in lumbar fusion influenced their prescription pattern.

### *Demographical information*

Demographics of the spinal surgeons were obtained by eight multiple choice questions. An open box for comments was added at the end of the questionnaire.

### **Data collection**

Data were collected anonymously between January and March 2018 by using the online survey tool SurveyMonkey®. Reminder e-mails were sent at one, two, four, five and six weeks. The survey tool accepted only one response for each IP-address. Incomplete responses were excluded. To increase the efficiency of the questionnaire, skip logic was added to obtain an estimated completion time of 4.30 minutes. Participants were able to review their answers while completing the questionnaire.

### **Statistical analysis**

Data management and statistical analysis were performed using R software (version 3.4.3). Descriptives were calculated by univariate frequency analysis. To investigate the association between two variables, a chi-square test and one-sided test for proportions was performed for nominal variables; a Cochran-Mantel-Haenszel test was used for ordinal variables. P-values < 0.05 were established as statistical significant.

## Results

### Surgeons' characteristics

A total of 105 questionnaires (response rate 42%) were returned of which eight were excluded due to incomplete answers, resulting in 97 questionnaires which were included for analysis. The characteristics of the respondents are shown in Table 1. Fifty-one per cent of the respondents were orthopaedic surgeons and 49% were neurosurgeons. One quarter was primarily affiliated with an academic setting and over half indicated to have completed a fellowship in spinal surgery. Furthermore, half of them had more than 20 years of experience as a qualified surgeon in spinal procedures, and a quarter did perform more than 80 lumbar fusions per year. In general, all age groups above 30 years old and all 10 provinces of Belgium were represented.

**Table 1** Characteristics of spinal surgeons who completed the survey (N= 97)

Characteristics	%
<b>Specialty</b>	
Orthopaedic	51
Neurosurgery	49
<b>Setting</b>	
Academic setting	26
Private practice	74
<b>Training</b>	
Fellowship	57
No fellowship	43
<b>Experience</b>	
<5 years	4
5-10 years	13
10-20 years	32
>20 years	51
<b>Lumbar fusions per year</b>	
<20	20
20-50	37
50-80	16
>80	27
<b>Gender</b>	
Female	2
Male	98
<b>Age</b>	
<30 years	0
30-39 years	11
40-49 years	33
50-59 years	41
>60 years	14

Table 2 outlines the types of lumbar surgery performed. Almost all surgeons reported performing lumbar discectomy (98%), lumbar laminectomy (93%), and TLIF/PLIF (90%). Within the fusion procedures, surgeons did perform more fusions with instrumentation than without. One out of four surgeons did perform lumbar arthroplasty or dynamic fixation.

**Table 2** Types of lumbar surgical procedures performed by spinal surgeons who completed the survey (N= 97)

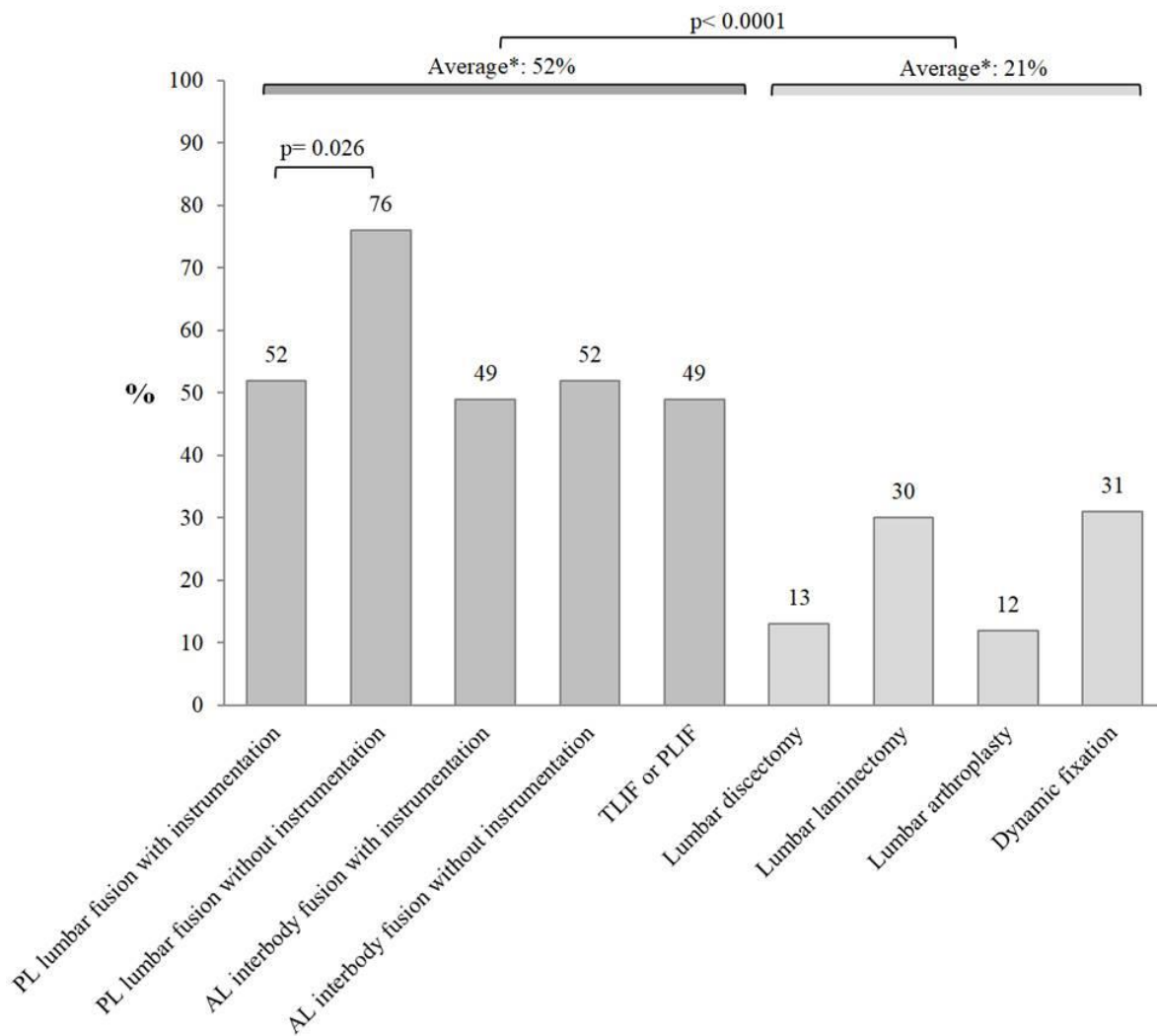
Type of lumbar surgery	Surgeons performing this type of surgery (%)
<b>Lumbar fusion procedure</b>	
Posterolateral lumbar fusion with instrumentation	92
Posterolateral lumbar fusion without instrumentation	26
Anterior/lateral interbody fusion with instrumentation	72
Anterior/lateral interbody fusion without instrumentation	22
TLIF or PLIF	90
<b>Other lumbar procedures</b>	
Lumbar discectomy	98
Lumbar laminectomy	93
Lumbar arthroplasty	26
Dynamic fixation	27

TLIF= transforaminal lumbar interbody fusion, PLIF= posterior lumbar interbody fusion

### Frequency of bracing following lumbar surgery

The frequency of bracing for each type of surgery is presented in Figure 1. After lumbar surgery, the overall frequency of prescribing a brace was 38%. The application of a brace after lumbar fusion was significantly higher than after other lumbar procedures (52% vs. 21%, respectively;  $p < 0.001$ ). Moreover, posterolateral fusion without instrumentation was more often followed by bracing than this procedure with instrumentation (76% vs. 52%,  $p = 0.026$ ). No other significant differences were found.

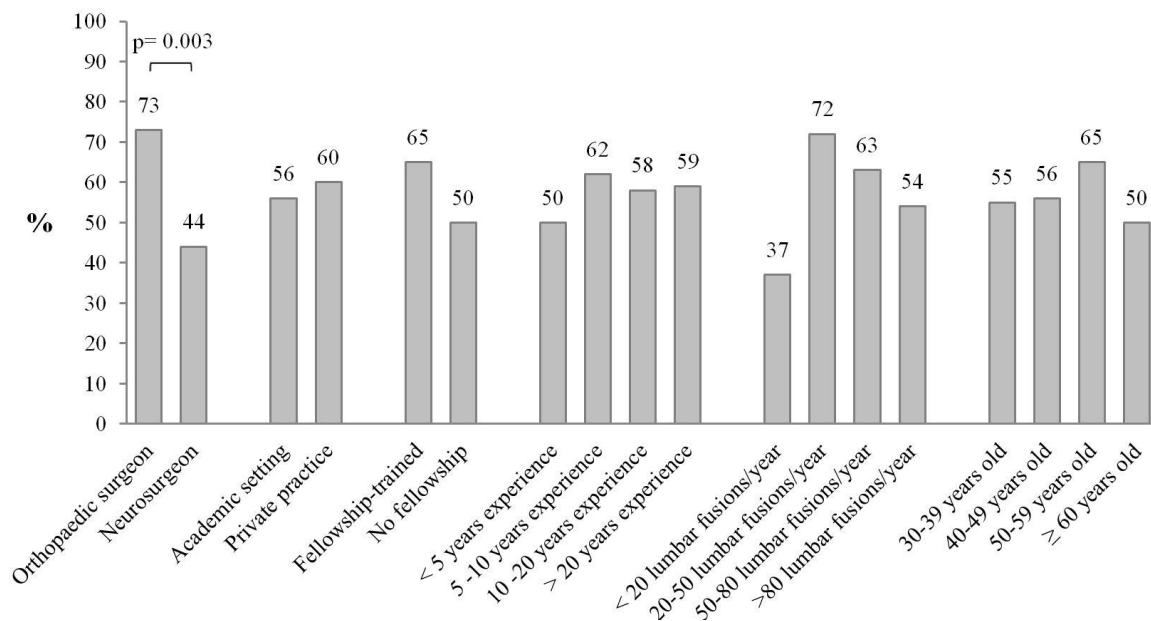




**Figure 1** Bracing frequency after each type of lumbar surgery. PL= posterolateral, AL= anterior/lateral, TLIF= transforaminal lumbar interbody fusion, PLIF= posterior lumbar interbody fusion.

\*The average frequencies noted above lumbar fusion procedures and above other lumbar procedures are weighted averages in function of how frequent each type of lumbar surgery was performed by the surgeons surveyed

The majority of surgeon respondents (59%) indicated to consider postoperative bracing after at least one type of lumbar procedure. Orthopaedic surgeons reported a significantly higher rate of postoperative bracing compared to neurosurgeons ( $p= 0.003$ ). Brace prescription was not influenced by work setting, training, years of experience, age or amount of fusions per year ( $p> 0.05$ ) (Figure 2).



**Figure 2** Percentage of surgeons who prescribe a brace following lumbar surgery, according to specialty, practice setting, fellowship training, years of experience, amount of lumbar fusions per year, and age in years of the surgeons in our population

### Types and duration of bracing

The majority of surgeons did choose for a lumbosacral orthosis (34% off the shelf and 20% custom moulded), followed by a lumbar corset (44%). A pelvic extension was rarely applied (1%). In the vast majority of regimes, bracing was continued for three to eight weeks (65%). Longer bracing (two to four months) was mentioned in 30% of the lumbar fusion or laminectomy procedures. The time frame of four months was never exceeded. Only a small amount of the surgeons did brace less than three weeks (4%) or case-dependently (1%).

### Rationale for bracing

Pain alleviation appeared to be the main goal when prescribing a brace following lumbar surgery (67%). Following fusion procedures, 42% of the surgeons believed the adjunct of a brace would increase the fusion rate. Furthermore, one out of three surgeons that prescribed a brace did have the intention to slow down the patient (37%). Length of bracing was mainly based on pain (45%) and type of surgery (39%). Additionally, bone quality (33%), level of function (26%) and age (26%) did have part in deciding whether or not to discontinue bracing.

The scientific literature (29%), personal experience (35%) and teaching from peers (36%) did contribute on a quasi-equal level in the decision towards prescribing bracing. This basis for decision-making was not different between surgeons who prescribed braces and their colleagues who did not ( $p > 0.05$ ). Only 14% of those who prescribed a brace following fusion procedures, indicated that their bracing regimes were influenced by the number of lumbar levels included in the lumbar fusion, i.e. more frequent bracing, longer duration or a different type of brace in case of longer constructs.

## Discussion

In terms of our first study objective, our results revealed that bracing following lumbar surgery is still frequently reported (38%) by spinal surgeons in Belgium, comparable to the reported rate by Bible et al (49%) [3]. Surgeons prescribed more often a brace after fusion procedures than after other lumbar procedures. This might stem from early history of lumbar fusion without instrumentation, where prolonged external immobilization by bracing was mandatory after surgery to ensure a 'stable' fusion [2]. However, advancements in surgical techniques and the increasing use of spinal instrumentation provide a solid internal immobilization [13, 14], thereby questioning the necessity of additional immobilization by bracing. Curiously, still one out of five surgeons commented to perform fusion procedures without instrumentation.

More than half of our respondents considered bracing after at least one type of lumbar surgery they performed. Remarkably, orthopaedic surgeons reported to prescribe more often a brace than their colleagues specialized in neurosurgery. We speculate that this might be partially due to their general orthopaedic training, offering them a higher exposure to use of orthoses in the treatment of different musculoskeletal disorders. The surgeons' work setting (academic vs. private), fellowship training or experience did however not affect their bracing practice. Also, self-reported attitudes towards bracing were equally influenced by the scientific literature, experience and training. Future studies should include more contextual factors to understand different attitudes towards bracing.

In terms of our second objective, to investigate the rationale, type and duration of postoperative bracing after lumbar surgery, our results showed that the main reason for prescribing a postoperative brace was pain relief. Interestingly, this prescription behaviour is in contrast with research that demonstrates that postoperative bracing has no effect on pain alleviation in either the short or the long-term [4, 9]. Recently, Soliman et al. did not show any benefit of bracing on pain assessed by the Visual Analogue Scale at three months follow-up [4]. Along similar lines, Yee et al. demonstrated that two years after surgery, patients who wore a brace had equivalent outcomes on the Dallas Pain Questionnaire as patients who didn't [9].

In addition, 42 % of the respondents aimed to improve fusion rate by postoperative bracing, despite lack of evidence that bracing affects segmental spinal stability (quantified by roentgen stereophotogrammetric analysis), nor loading on the internal fixation of the spine (measured using telemetrised fixators) [6-8], nor radiographically assessed fusion rates at one and two years follow-up [9].

Finally, only one-third of our respondents intended to slow down the patient with bracing, whereas this was the most common justification for bracing according to Bible et al. [3]. One possible explanation is the shift in attitude regarding postoperative mobilisation during the last decade. In the past, surgeons were concerned that gross body motions of the operated spine would lead to less favourable outcomes [2]. In the last few years, however, there is growing evidence that the opposite, fear and avoiding of movement, is associated with poorer postoperative functional outcomes [15].

In terms of type and duration of bracing, our respondents reported mostly the use of a lumbosacral orthosis during three to eight weeks, mainly depending on pain control after lumbar surgery. Interestingly, in 39% of the regimes, duration of bracing was defined even before the surgery. These findings suggest that some surgeons prescribe braces for "pain that will come".

Interestingly, two-third of the surgeons reported that their decision towards whether or not bracing was eminence-based, i.e. based on personal experience and teaching from peers, rather than evidence-based. This finding underlines how crucial surgeons' beliefs are in current clinical practice. In contrast to these findings, the AANS discourages the prescription of a brace following lumbar fusion for degenerative conditions [10]. This recommendation in 2014 was based on a randomized controlled trial by Yee et al. [9] that observed equivalent functional and radiographic outcomes with and without bracing. Recently, this guideline was endorsed by the Dutch Association of Medical Specialists [16]. However, to the best of the authors' knowledge, there are no further European guidelines regarding this subject. It should also be noted that the guideline of the AANS consists of only one prospective randomized trial [9], therefore providing low-quality evidence according to the North American Spinal Society recommendation grades (grade C). Recently however, an additional randomized controlled trial also showed no functional benefit with bracing and thereby may strengthen future guidelines [4]. Despite the fact that postoperative bracing is not recommended by scientific literature, our study suggested that bracing remains surrounded by controversy, and implementation of research in clinical practice lags behind.

Furthermore, it is plausible that, by prescribing a brace driven by non-evidence based beliefs, surgeons sent their patients messages such as "bracing for the pain (that will come)", "bracing to protect the fusion (that is fragile)" or "bracing to restrict movements (that are harmful)". However, there is growing concern that negative beliefs about pain may fuel fear-avoidance of movement, thereby feeding a vicious cycle of pain [17]. Furthermore, Archer et al. demonstrated that higher levels of kinesiophobia after lumbar surgery were associated with poorer postoperative outcomes regarding pain, disability and physical health [15]. In addition, several authors have advocated the importance of patient education and early mobilisation in lumbar surgery rehabilitation in order to prevent this vicious cycle of pain [18, 19].

### **Socio-economic implications**

The results of this study imply that postoperative bracing is associated with a high cost for our society, although the clinical benefit is minimal. On a yearly basis the Belgian social security system reimburses 17 million euros on lumbar braces, of which three million euros is spent on postoperative lumbar braces (data from 2012 and 2014, received from IMANI/RIZIV). Health care policy makers have restricted financial resources and are continuously seeking how to spend those resources as efficient and effectively as possible. One of the potential opportunities lays in only intervening in spine care with a high probability of health benefit. Nevertheless, encouraging simultaneously clinicians to change their prescription practice will likely be required [20]. This combined approach has been widely adopted in the field of behavioural economics in health [20-22]. Understanding the current beliefs and habits of prescribing postoperative bracing is a first step on the path towards change.

### **Limitations**

We acknowledge that our study may have a number of limitations. The main limitation is our relatively low response rate (42%). Although, recent surveys of spinal surgeons in other European countries showed similar response rates [23]. Further, it is possible that surgeons who responded were more interested in bracing or science in general, and therefore had possible other opinions than non-responders. Selection bias may also be present by inquiring only the members of the SSBe. In order to investigate this potential bias, we compared the characteristics

of the surgeons surveyed with those of all spinal surgeons in Belgium. This information was provided by the National Institute of Health and Disability Insurance, and showed broadly comparable characteristics (data not shown). Finally, it is possible that the self-reported prescription patterns did not perfectly correlate with the actual clinical practice. However, this limitation is inherent to a survey-design.

## **Conclusion**

In summary, Belgian spinal surgeons reported postoperative bracing following more than one third of lumbar procedures. Despite recent insights in literature, bracing regimes are mainly influenced by beliefs about pain relief and improved fusion rate. Furthermore, bracing might even be disadvantageous in terms of fear avoidance beliefs. It is important to invest in endorsed and practical guidelines regarding the non-sense of postoperative bracing after lumbar spine surgery for degenerative pathology.

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