An age and sex matched study on the effect of obesity on the functional outcomes and complication rates in patients with adult spinal deformity undergoing primary multi-level thoracolumbar spinal fusion

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Background: The objective of this study was to determine the effect of obesity on the functional outcomes and complication rates of patients with adult spinal deformity (ASD) undergoing multi-level thoracolumbar fusion.

Methods: An age and sex matched comparison of functional outcomes [Numeric Rating Scale (NRS) back and leg scores, Core Outcome Measurement Index (COMI) back scores, Scoliosis Research Society 22 (SRS22) satisfaction and total scores, Short Form 36 (SF36) general health scores, Physical Component Score (PCS), Mental Component Score (MCS), Oswestry Disability Index (ODI) (including all domains)] at 6 months, 1, 2, 3 and 4 years and the complication rates at final follow-up between obese [body mass index (BMI) >30] and normal BMI (18.5–24.9) patients undergoing more than 3 levels of thoracolumbar fusion with a minimum 2-year follow-up. Patients who had undergone any previous spinal surgery were excluded.

Results: Thirty patients were included in each arm of the study. Baseline demographics, including the number of levels fused, were similar between the groups. Estimated blood loss (EBL) was higher in obese patients (1,916 *vs.* 1,099 mL, P=0.001), but operative time was similar (282 *vs.* 320 min, P=0.351). The functional outcomes and satisfaction scores were consistently poorer in the obese group at all time-points, but their satisfaction scores were similar. Obese patients had a higher complication rate (OR 3.05, P=0.038) predominantly due to dural tears and nerve root injuries, but a similar reoperation rate.

Conclusions: In patients with ASD undergoing multi-level thoracolumbar fusion, obesity results in a higher blood loss, poorer sagittal correction, poorer post-operative functional scores and higher complication rates than patients with a normal BMI. However, obesity does not affect operative times, length of hospital

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stay or reoperation rates. Furthermore, patients with obesity have similar post-operative satisfaction scores to patients with normal BMIs.

Keywords: Obesity; body mass index (BMI); spine; fusion; deformity

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Introduction

Adult spinal deformity (ASD) is an umbrella term for a broad group of spinal pathologies causing malalignment in the frontal and/or sagittal plane. The rates of ASD have been estimated at 30% in those aged over 50 years and 68% in those aged over 70 years (1). In extreme cases ASD may lead to severe disability requiring operative intervention (2). However, operative intervention carries significant risk and not all patients benefit equally.

Concurrently the obesity epidemic is a growing concern internationally (3,4). Within hip and knee arthroplasty it is clear that obesity increases the risk of complications, but there is debate as to whether it affects the functional benefits (5-7). In the spinal literature it has been suggested that patients with obesity have similar functional benefits but higher complication rates following surgery than those without obesity (8,9). While multiple factors influence outcome, the effect of obesity and its influence on successful outcomes and complications of surgery remains unclear. The previous spinal literature has simply grouped patients into cohorts and not accounted for the variances in age, sex, previous operations, number of levels operated or whether there is a significant spinal malalignment. With the advent of spinal registries, it now becomes possible to account for these variances with large data analytics. The European Spine Study Group (ESSG) has now collected data on over 2,500 patients with ASD allowing comparisons to be made between specific cohorts.

The purpose of this study was to compare the functional outcomes and complication rates between obese and normal body mass index (BMI) patients undergoing primary multi-level thoracolumbar fusion within the ESSG and to determine which functional activities are most affected by obesity. We present this study in accordance with STROBE reporting checklist (available at https://aoj.amegroups.com/article/view/10.21037/aoj-22-14/rc).

Methods

Study design

We performed a retrospective age and sex matched multi-center study of prospectively collected data on ASD patients from six spine centers following informed consent. Institutional review board (IRB) approval at University Hospital Bordeaux France was obtained at each site for patient enrollment and data collection (No. CE-GP-2019-16). Inclusion criteria were patients with degenerative or idiopathic spinal deformity undergoing more than 3 levels of primary thoracolumbar fusions, with the lowest instrumented level being in the lumbar or sacral spine, presenting with at least one criteria: Coronal cobb ≥20°; sagittal vertical axis (SVA) ≥5 cm; thoracic kyphosis (TK) ≥60° or pelvic tilt (PT) ≥25°. Exclusion criteria were: patients under the age of 18 years or any prior spinal surgery. The minimum follow-up was two years. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Patients were classified according to their BMI at presentation. Patients were grouped into obese (BMI ≥30) or normal (BMI 18.5–24.9). Baseline demographics of age, sex, American Society of Anaesthesiologist (ASA) score, employment status, smoking status, surgical approach, osteotomy requirements and number of levels instrumented and decompressed were compared. The initial radiographic parameters were assessed by the same single observer at each site for the major coronal cobb angle, coronal [C7 to central sacral vertical line (CSVL)] and sagittal balance (SVA), and pelvic incidence minus lumbar lordosis (PI-LL) mismatch were compared. The duration of follow-up was also recorded.

Subsequently, the surgical time and estimated blood loss (EBL) were compared between the groups. Then the radiographic parameters (Major curve Cobb angle, coronal balance (C7 plumbline to CSVL) and sagittal balance, PI-

LL) at 6 months were compared to estimate the capacity to correct the deformity.

We compared the following patient scores preoperatively and at 6 months, 1, 2, 3 and 4 years: Numeric Rating Scale (NRS) back and leg scores, Core Outcome Measurement Index (COMI) back score, Short Form 36 (SF36) score [general health, Physical Component Score (PCS) and Mental Component Score (MCS)], Scoliosis Research Society 22 (SRS22) satisfaction and total scores and Oswestry Disability Index (ODI) scores (including all domains). Lastly, the complication rate and complication profile as well as the reoperation rate at final follow-up were compared.

Statistical analysis

We provide a mean and standard deviation for all values except sex, ASA, employment status, smoking status, surgical approach, osteotomies, complications and reoperations for which we provide absolute values. We used a two-tailed *t*-test for continuous data and a chi-squared test for categorical variables. Gaussian distribution was checked with the Kolmogorov-Smirnov test. We determined the complication and reoperation risk with an odds ratio between the groups. A P value less than 0.05 was considered statistically significant.

Results

As of 1 November 2018, 2,523 adult patients were enrolled in the ESSG database. Of these there were 34 obese patients who met our inclusion and exclusion criteria. Thirty of these patients were able to be age and sex matched to normal BMI patients who met the same criteria. *Table 1* compares the baseline demographics between the groups. *Table 2* displays the operative comparison between the groups as well as the 6 months radiographic parameters. *Table 3* shows the functional outcomes between the groups including the sub-domains of the ODI score. *Table 4* shows the complication profile and reoperation rate between the groups.

Discussion

This study is the first age and sex matched comparison of obese and normal BMI patients with ASD undergoing primary multi-level thoracolumbar fusion. Djurasovic and colleagues previously assessed the effect of obesity on clinical outcomes after lumbar fusion in a retrospective review of 270 patients and found similar benefits in NRS back and leg scores, ODI scores and SF-36 scores (8). Our results support these findings with improvements in all outcome scores seen for both obese and non-obese patients after operative intervention. However, consistently, obese patients reported worse overall functional scores than normal BMI patients, but these were only statistically significant for the 6-month ODI total score, 1-year NRS leg score, 2-year SF36 general health, 4-year COMI back, SRS-22 total, SF36 MCS and ODI total score. Eleven obese patients and 10 normal BMI patients had 4-year functional score results recorded therefore the authors advise caution in interpreting the statistics of the 4-year results.

When specifically assessing which ODI domains were affected by obesity, we identified comparable pain scores, sitting and sleeping, but worse personal cares, lifting, walking, standing, sex life, social life and travelling in obese patients. These results are somewhat expected. Anecdotally, the analgesic effect of operative intervention is similar between obese and normal BMI patients and the relative effect of spinal fusion in obesity to affect sitting and sleeping is likely minimal. However, the mechanical rigidity imparted by multi-level fusion may have a greater effect on other functions in obese patients. Specifically, personal care is likely affected by the physical challenge of reaching the perineal region and feet around increased body habitus with a restricted spinal motion. The capacity to lift is again affected by body habitus which limits a patient's capacity to lift an object from the floor. Similarly, obesity may be a surrogate measure for fitness and therefore obese patients are expected to have a poorer walking, standing, and travelling function. The effect on sexual and social life may be independently related to obesity, but exacerbated by restricted spinal motion.

However, despite the consistently poorer functional scores, we found comparable satisfaction scores between the groups at all time points. This suggests that the patient's perception of their treatment outcome is personal and not specifically determined by the factors measurable with current functional outcome scores.

A systematic review of the literature on the effect of obesity in spinal surgery showed that obesity was associated with higher risks of surgical site infection, venous thrombo-embolism, increased blood loss and longer surgical times (9). In contrast to this review, which studied all spinal procedures, our age and sex matched study of multi-level fusion found a greater blood loss in the obese group (EBL 1,916 mL in obese group *vs.* 1,099 mL in normal BMI

Table 1 Demographic comparison between the groups

Patient demographics	Obese group (N=30)	Non-obese group (N=30)	Statistical significance (P value)
Age (years)	63.0 (SD 14.7)	63.0 (SD 14.7)	–
Number of males	3	3	–
Average BMI	33.2 (SD 3.6)	22.3 (SD 1.6)	<0.01
ASA grade			
1	0	7	
2	26	16	
3	4	7	
Average	2.1 (SD 0.3)	2 (SD 0.7)	0.351
Employment status			0.684
Unemployed	3	4	
Retired	16	14	
Employed or student	11	12	
Smoking status			0.312
Current	3	8	
Ex-smoker	4	3	
Non-smoker	23	19	
Preoperative radiographic parameters			
Major cobb	33.8 (SD 22.1)	39.9 (SD 19.4)	0.269
Coronal balance	21.0 (SD 14.9)	22.9 (SD 28.4)	0.756
Sagittal balance	57.8 (SD 54.7)	42.8 (SD 51.1)	0.294
PI-LL mismatch	14.8 (SD 20.2)	16.5 (SD 20.6)	0.753
Follow-up (years)	3.1 (SD 1.3)	3.2 (SD 1.1)	0.663

BMI, body mass index; ASA, American Society of Anaesthesiologist; PI-LL, pelvic incidence minus lumbar lordosis.

group, P=0.001), but not a significant difference in operative time. We identified a higher complication rate (OR 3.05, P=0.038), predominantly due to dural tears and nerve root injury, but not a higher reoperation rate between the groups (OR 1.38, P=0.694).

The cause of a higher complication rate between obese and non-obese patients is likely multi-factorial. Higher complication rates are known to be associated with higher ASA scores, medical co-morbidities, prolonged operative times and greater blood loss, all of which are usually more prevalent in obese patients undergoing operative intervention (10). But, in our review only the EBL was significantly higher in the obese group. Furthermore, the complication profile, illustrating a preponderance for dural and nerve root injuries, which are intraoperative complications, would suggest that the technical complexity of these procedures is increased in obese patients.

This study has a number of limitations. Firstly, it is inhibited by relatively low numbers. In order to improve specificity, we only included adult patients with ASD with a minimum of 2-year follow-up and who were undergoing multi-level thoracolumbar fusion and had never had a previous spinal operation. Subsequently, we performed an age and sex matched comparison which limited our numbers to 60 patients. However, reassuringly the baseline demographics, including ASA, smoking status, employment status, pre-operative radiographic parameters, number of levels fused and decompressed were similar between the groups. Thus, we feel this study offers a fair comparison between the groups.

Table 2 The operative comparison between the obese and non-obese groups

Operative factors	Obese group	Non-obese group	Statistical significance (P value)
Number of levels fused	10.1 (SD 3.2)	9.6 (SD 3.1)	0.600
Number of levels decompressed	1.1 (SD 1.4)	0.8 (SD 1.3)	0.446
Operative time (minutes)	282.1 (SD 140.4)	319.5 (SD 161.3)	0.351
Estimated blood loss (mL)	1,916.0 (SD 1,032.0)	1,099.0 (SD 694.2)	0.001*
ICU length of stay (hours)	32 (SD 31.7)	29.5 (SD 37.2)	0.784
Hospital length of stay (days)	13.2 (SD 13.4)	11.3 (SD 3.2)	0.451
Surgical approach			
Posterior	29 (96.7%)	28 (93.3%)	
Anterior	0	0	
Combined	1 (3.3%)	2 (6.7%)	
Osteotomy			
Any osteotomy	16 (53.3%)	14 (46.7%)	0.613
3 column osteotomy	4 (13.3%)	4 (13.3%)	1.0
6 months radiographic parameters			
Major cobb	16.1 (SD 9.4)	17 (SD 8.7)	0.988
Coronal balance	23.4 (SD 16.5)	16.2 (SD 11.8)	0.120
Sagittal balance	45.3 (SD 40.9)	19.3 (SD 33.1)	0.034*
PI-LL mismatch	8.9 (SD 16.8)	7.7 (SD 11.1)	0.778

*, P<0.05. ICU, intensive care unit; PI-LL, pelvic incidence minus lumbar lordosis.

Another limitation is that the post-operative sagittal balance significantly varied between the groups (SVA 45.3 mm obese group *vs.* 19.3 mm normal BMI group, P=0.034) despite the similarity in osteotomy requirements. This illustrates the challenges in deformity correction in obese patients, which is a notable result in its own right, but it should also be recognised that sagittal balance directly affects functional outcomes and therefore this result may affect our functional outcome findings (11).

Another limitation is the variable construction lengths and lower instrumented vertebrae. We chose to limit this study to more than 3 instrumented levels with the lowest instrumented level being in the lumbar or sacral spine, in order to broadly assess the risk in multi-level thoracolumbar fusion. However, further research into longer construct lengths and variance on the lower instrumented level should be considered. Lastly, we elected to only assess primary procedures to limit confounders. While it is commonly thought that revision surgery is an independent risk factor for post-operative complications, there remains literature contradicting this presumption (12). Further research into the merits of revision surgery in obese patients is warranted.

Despite these limitations, this study illustrates that obesity incurs a higher blood loss and poorer sagittal correction in patients with ASD undergoing multi-level thoracolumbar fusion. Furthermore, obese patients have consistently poorer functional outcomes, predominantly affecting personal cares, lifting, walking, standing, sex life, social life and travelling, as well as statistically higher complication rates, predominantly due to technical difficulties, when compared to normal BMI patients. However, their operative times, length of hospital stay, reoperation rates and satisfaction scores are similar to patients with a normal BMI.

Conclusions

In patients with ASD undergoing multi-level thoracolumbar fusion, obesity results in a higher blood loss, poorer sagittal correction, poorer post-operative functional scores and

Table 3 Functional outcome scores between the groups

Functional scores	Obese group, mean (SD)	Non-obese group, mean (SD)	Statistical significance (P value)
NRS back pain scores			
Preoperatively	7.02 (2.9)	6.8 (2.4)	0.779
6 months	3.6 (2.6)	3.3 (2.5)	0.665
1 year	3.9 (2.6)	3.2 (2.5)	0.372
2 years	4.2 (2.9)	3.5 (2.6)	0.393
3 years	3.4 (3.4)	3.3 (2.3)	0.959
4 years	5.6 (3.4)	4.3(2.9)	0.659
NRS leg pain scores			
Preoperatively	5.3 (3.3)	4.6 (3.3)	0.400
6 months	4.2 (3.1)	2.6 (2.7)	0.057
1 year	4.1 (3.2)	2.2 (2.6)	0.031*
2 years	4.0 (3.3)	2.3 (3.1)	0.095
3 years	3.4 (2.9)	2.2 (2.7)	0.356
4 years	6.0 (3.8)	4.3(2.5)	0.579
COMI back pain scores			
Preoperatively	7.5 (2.6)	6.2 (2.5)	0.073
6 months	4.2 (2.1)	4.0 (2.0)	0.721
1 year	4.1 (2.5)	2.8 (1.9)	0.072
2 years	4.4 (2.7)	3.2 (2.7)	0.144
3 years	4.8 (3.1)	2.4 (2.3)	0.067
4 years	6.5 (2.8)	2.1 (1.7)	0.018*
SRS22 satisfaction scores			
Preoperatively	2.9 (1.1)	2.8 (1.2)	0.828
6 months	4.3 (0.8)	4.3 (0.8)	0.895
1 year	3.9 (1.0)	4.3 (1.0)	0.130
2 years	3.9 (1.0)	4.2 (1.1)	0.314
3 years	4.1 (1.2)	4.4 (0.7)	0.391
4 years	3.9 (0.9)	4.6 (0.7)	0.185
SRS22 total scores			
Preoperatively	2.6 (0.6)	2.9 (0.7)	0.215
6 months	3.5 (0.6)	3.6 (0.7)	0.631
1 year	3.3 (0.7)	3.6 (0.7)	0.170
2 years	3.3 (0.8)	3.6 (0.8)	0.234
3 years	3.5 (0.9)	3.9 (0.7)	0.260
4 years	2.8 (0.9)	4.0 (0.5)	0.023*

Table 3 (*continued*)

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Functional scores	Obese group, mean (SD)	Non-obese group, mean (SD)	Statistical significance (P value)
SF36 general health scores			
Preoperatively	42.4 (11.2)	45.8 (8.5)	0.198
6 months	48.0 (8.8)	49.0 (11.0)	0.730
1 year	48.6 (10.6)	50.3 (9.9)	0.563
2 years	43.6 (11.6)	49.6 (9.9)	0.050*
3 years	45.7 (13.6)	51.9 (8.3)	0.207
4 years	38.8 (13.6)	48.6 (7.0)	0.168
SF36 PCS			
Preoperatively	32.0 (6.9)	37.3 (9.9)	0.024*
6 months	37.3 (8.0)	40.8 (8.4)	0.123
1 year	39.4 (9.6)	42.4 (8.8)	0.276
2 years	36.6 (11.6)	42.0 (8.7)	0.061
3 years	37.6 (12.0)	46.1 (8.7)	0.078
4 years	31.9 (10.0)	43.3 (12.4)	0.153
SF36 MCS			
Preoperatively	41.5 (12.7)	43.1(13.0)	0.642
6 months	47.5 (11.3)	47.1 (11.9)	0.889
1 year	44.3 (11.2)	46.9 (11.6)	0.424
2 years	48.3 (10.1)	49.4 (13.4)	0.722
3 years	48.1 (9.1)	51.3 (10.2)	0.496
4 years	38.3 (11.5)	56.1 (7.0)	0.012*
ODI pain scores			
Preoperatively	3.2 (1.2)	2.6 (1.5)	0.104
6 months	1.7 (1.1)	1.4 (1.3)	0.356
1 year	1.7 (1.3)	1.5 (1.2)	0.439
2 years	1.6 (1.4)	1.6 (1.3)	1.00
3 years	1.8 (1.0)	1.3 (1.1)	0.318
4 years	2.8(1.5)	0.9 (1.1)	0.040*
ODI personal care scores			
Preoperatively	1.4 (1.3)	1.0 (1.1)	0.184
6 months	1.9 (1.3)	0.8 (1.1)	0.002*
1 year	1.7 (1.7)	0.8 (1.3)	0.061
2 years	1.4 (1.4)	0.8 (1.4)	0.139
3 years	1.6 (1.3)	0.3 (1.0)	0.021*
4 years	3.2 (1.0)	0.1(0.3)	<0.001*

Table 3 (*continued*)

Table 3 (*continued*)

Functional scores	Obese group, mean (SD)	Non-obese group, mean (SD)	Statistical significance (P value)
ODI lifting scores			
Preoperatively	3.8 (1.2)		
6 months	3.3 (1.4)		
1 year	3.3 (1.7)		
2 years	3.1 (1.9)		
3 years	3.1 (1.5)		
4 years	3.4 (1.4)		
ODI lifting scores			
Preoperatively	3.8 (1.2)	2.8 (1.4)	0.005*
6 months	3.3 (1.4)	2.9 (1.4)	0.255
1 year	3.3 (1.7)	2.8 (1.5)	0.205
2 years	3.1 (1.9)	2.2 (1.5)	0.068
3 years	3.1 (1.5)	1.9 (1.6)	0.100
4 years	3.4 (1.4)	2.1 (1.6)	0.229
ODI walking scores			
Preoperatively	2.9 (1.6)	1.4 (1.3)	0.000*
6 months	2.0 (1.7)	0.8 (1.4)	0.005*
1 year	2.2 (1.6)	1.3 (1.7)	0.078
2 years	2.3 (1.8)	1.0 (1.3)	0.004*
3 years	1.6 (1.5)	0.5 (1.0)	0.062
4 years	3.2 (1.7)	0.6 (0.5)	0.006*
ODI sitting scores			
Preoperatively	2.0 (1.4)	1.7 (1.0)	0.331
6 months	1.3 (1.0)	1.5 (1.0)	0.494
1 year	1.2 (1.0)	1.3 (1.0)	0.706
2 years	1.0 (1.2)	1.3 (1.1)	0.356
3 years	1.1 (0.9)	0.7 (0.9)	0.367
4 years	1.2 (1.0)	0.4(0.7)	0.182
ODI standing scores			
Preoperatively	3.5 (1.2)	2.7 (1.2)	0.023*
6 months	2.04 (1.5)	1.5 (1.0)	0.147
1 year	2.2 (1.5)	1.6 (1.3)	0.129
2 years	2.1 (1.7)	1.6 (1.3)	0.250
3 years	2.4 (1.8)	1.3 (1.3)	0.150
4 years	3.0 (1.8)	1.1 (1.4)	0.091

Table 3 (*continued*)

Table 3 (*continued*)

Functional scores	Obese group, mean (SD)	Non-obese group, mean (SD)	Statistical significance (P value)
ODI sleeping scores			
Preoperatively	1.5 (1.6)	0.9 (1.2)	0.102
6 months	0.76 (1.1)	0.4 (1.0)	0.234
1 year	0.8 (1.2)	0.9 (1.3)	0.780
2 years	1.3 (1.4)	0.8 (1.0)	0.107
3 years	0.8 (1.1)	0.3 (0.4)	0.166
4 years	2.6 (1.6)	0.4 (0.7)	0.017*
ODI sex life scores			
Preoperatively	3.1 (1.4)	2.5 (1.6)	0.273
6 months	2.4 (1.2)	2.0 (1.4)	0.409
1 year	2.1 (1.4)	1.6 (1.7)	0.469
2 years	2.0 (1.4)	1.2 (1.6)	0.216
3 years	4.0 (1.0)	0.5 (1.1)	N/A
4 years	3.0 (2.2)	0.2 (0.4)	0.051
ODI social life scores			
Preoperatively	3.2 (1.0)	2.2 (1.6)	0.018*
6 months	2.5 (1.3)	1.8 (1.3)	0.102
1 year	2.1 (1.4)	1.6 (1.4)	0.240
2 years	2.3 (1.8)	1.4 (1.5)	0.096
3 years	2.7 (1.4)	0.9 (1.0)	0.604
4 years	2.6 (1.9)	1.4 (1.3)	0.267
ODI travelling scores			
Preoperatively	2.7 (1.4)	2.1 (1.5)	0.160
6 months	1.9 (0.9)	1.4 (1.1)	0.104
1 year	1.9 (1.5)	1.6 (1.3)	0.598
2 years	1.4 (1.4)	1.3 (1.3)	0.712
3 years	1.0 (1.2)	0.7 (1.0)	0.604
4 years	2.4 (1.2)	0.6 (0.7)	0.014*
ODI total scores			
Preoperatively	51.7(18.2)	38.7 (19.4)	0.012*
6 months	36.1 (17.9)	26.3 (15.0)	0.035*
1 year	36.6 (19.6)	28.1 (21.0)	0.151
2 years	35.6 (22.1)	25.4 (20.5)	0.088
3 years	34.0 (20.6)	17.4 (18.4)	0.073
4 years	54.2 (23.9)	16.7 (15.1)	0.013*

*, P<0.05. NRS, Numeric Rating Scale; COMI, Core Outcome Measurement Index; SRS22, Scoliosis Research Society 22; SF36, Short Form 36; PCS, Physical Component Score; MCS, Mental Component Score; ODI, Oswestry Disability Index; N/A, not available.

Table 4 The complication profile and reoperation rates between the obese and non-obese groups

Complications	Obesity group	Non-obese group	Odds ratio	Statistical significance (P value)
Total	21	13	3.05	0.038*
Complication				
Mechanical				
Proximal junctional kyphosis	0	3		
Rod breakage	0	0		
Screw pull-out	2	0		
Metalware irritation	1	1		
Pseudarthrosis	1	1		
Neurological				
Cord	1	0		
Nerve root	7	2		
Dural tear	4	2		
Infectious				
Deep	1	0		
Superficial	1	2		
Other	1	0		
Medical	2	2		
Reoperation	4	3	1.38	0.694

*, P<0.05.

higher complication rates than patients with a normal BMI. However, obesity does not affect operative times, length of hospital stay or reoperation rates. Furthermore, patients with obesity have similar post-operative satisfaction scores to those with normal BMIs.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://aoj.amegroups.com/article/view/10.21037/aoj-22-14/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Institutional review board (IRB) approval at University Hospital Bordeaux France was obtained at each site for patient enrollment and data collection (No. CE-GP-2019-16) and informed consent was taken from all individual participants.

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