Research Square

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Comorbid conditions account for nearly one-third of unacceptable disability cases after lumbar decompressive surgery.

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Tables 1 to 5 are available in the Supplementary Files section.

Comorbid conditions account for nearly one-third of unacceptable disability cases after lumbar decompressive surgery.

Abstract

Purpose: To determine the proportion of patients with unacceptable disability secondary to comorbid (non-lumbar) conditions following lumbar decompressive surgery.

Methods: This single-centre study analysed prospectively collected data from 1,524 who underwent surgery between 01/01/2020 and 30/06/2025. We used postoperative Oswestry Disability Index (ODI) scores to classify patients as having acceptable disability (ODI≤22) or unacceptable disability (ODI>22). Patients with ODI>22 were categorised by disability primarily attributable to either a lumbar or comorbid condition, based on clinical assessment and medical record review. We compared baseline characteristics and outcomes across disability groups.

Results: Twelve-month ODI was completed by 78.3% (1,193/1,524), while 14.2% (216/1,524) completed their last ODI at three months. Comorbid conditions accounted for 29.2% (150/514) of unacceptable disability at 12 months and 30.1% (31/103) of last ODI at three months. Forty-four of 150 (29.3%) with a 12-month comorbid condition achieved acceptable disability at three months before worsening. The most frequent comorbid conditions were lower-limb joint osteoarthritis, multiple conditions, brain diseases, cervicogenic disorders, and lower-limb musculoskeletal disorders. Notable baseline factors associated with comorbid condition included older age, female sex, previous lower-limb arthroplasty, public-funded healthcare, current smoker, ASA class 3, and anxiety/depression. Comorbid condition was associated with prolonged length of stay (p=0.042).

Conclusion: Comorbid conditions account for more than 29% of cases with unacceptable disability after lumbar decompressive surgery. Extended postoperative access to specialist review is needed to ensure accurate diagnosis and treatment. National spinal registries should capture postoperative events and comorbid conditions that affect patient-reported outcomes to support accurate clinical interpretation.

Keywords: comorbid, lumbar decompressive surgery, national spinal registries, Oswestry Disability Index

Introduction

National spinal surgery registries have been established to improve cost-efficiency and monitor clinical practice at the national, hospital, and consultant levels [1]. Patient-reported outcome measures (PROMs) are key indicators of spinal surgical outcome, capturing residual symptoms and changes in health from the patient's perspective [2]. Increasingly, registry data are used to develop tools that predict 12-month PROMs; these tools support shared decision-making by estimating the likelihood of an acceptable result [3]. However, the precise mechanism by which prediction tools improve clinical outcomes remains to be established [4].

Twelve-month disability PROM results indicate that 25–33% of patients experience an unacceptable outcome following lumbar decompressive surgery [5, 6]. Importantly, the presence of clinically significant symptoms does not automatically indicate surgical failure. Experts advocate the term 'persistent spinal pain syndrome type 2' (PSPS-T2) to describe persistent or recurrent postoperative spinal symptoms that a specialist does not attribute to another identifiable condition [7, 8]. PSPS-T2 encompasses a complex range of surgically operable or non-operable aetiologies [8]. Surgical failure, narrowly defined by revision surgery within 12 months, occurs in approximately 4% of patients, while the prevalence of PSPS-T2 is close to 15% [9-11]. The proportion of patients with unacceptable outcome primarily attributable to non-lumbar comorbid conditions remains unknown.

Comorbid conditions associated with poorer spinal PROMs include concomitant hip or knee osteoarthritis (OA) and new-onset psychiatric disorders [12-14]. Conversely, lower-limb arthroplasty may improve back pain in patients with lumbar degenerative disease [14, 15]. A better understanding of how lower-limb osteoarthritis and arthroplasty influence postoperative spinal PROMs is required.

The primary aim was to determine the proportion of patients with unacceptable 12-month disability predominantly attributed to a comorbid condition. The secondary aims were to: (1) compare patients with acceptable disability, lumbar condition-attributed disability, and comorbid condition-attributed disability; and (2) evaluate the association of lower-limb osteoarthritis and arthroplasty with postoperative spinal PROMs.

Methods

We hypothesised comorbid conditions would account for a substantial proportion of cases with unacceptable disability outcome after lumbar decompressive surgery. This study was reported in accordance with the STROBE statement [16].

The primary PROM was the Oswestry Disability Index (ODI), a 10-item back-related disability PROM (0–100%, least–worst disability) [2]. Secondary PROMs were visual analogue scales (VAS) to measure average weekly back and leg pain (0–10, none–worst imaginable), and the 5-item 5-level EuroQol (EQ-5D) to measure health-related quality of life (-0.594–1.000, worst–best health) using the UK value set [2]. PROM scores were evaluated by mean score and, from a patient-centric perspective, achievement of a patient acceptable symptom state (PASS) or minimal clinically important difference (MCID). PASS represents an outcome threshold where the patient is satisfied with the current health state, while MCID represents a meaningful change in symptoms. PASS was defined as ODI≤22, pain≤3, or EQ-5D≥0.692, and MCID was defined as a ≥30% reduction in preoperative ODI or pain, or an absolute increase in preoperative EQ-5D by ≥0.105 [17-20]. The PROMs are valid, reliable, and responsive outcomes for lumbar surgery [2].

An unacceptable disability outcome was defined as ODI>22, signifying failure to achieve the ODI PASS threshold [17].

Consecutive patients undergoing lumbar decompressive surgery (with or without fusion) under the care of six spinal consultants were included from a tertiary private hospital between 01/01/2008 and 30/06/2025. Exclusion criteria were >3 operative levels, no PROM consent, and reoperation or death within 12 months.

Patients were consented for PROM collection at pre-assessment and, from 01/01/2015, enrolled on the British Spine Register. Baseline demographic, medical, surgical, and imaging data were prospectively collected from pre-assessment, spinal surgeon and hospital notes, and the radiology database. Postoperative PROMs were principally collected at physiotherapy or by post at 3 months, and electronically or by post at 1 year. Patients received physiotherapy at the centre up to 3 months, with

extension up to 12 months when clinically indicated. Surgeon follow-up occurred at ≤2 weeks and 6–8 weeks, with further reviews when clinically indicated.

Reasons for unacceptable outcome were prospectively collected between 01/01/2020 and 30/06/2025. Patients were assigned to one of three ODI categories: (1) acceptable disability (ODI≤22); (2) lumbar condition (ODI>22 and disability predominantly attributed to the lumbar neural system or spine); and (3) comorbid condition (ODI>22 and disability was predominantly attributed to a comorbid condition, e.g., hip OA, or an event, e.g., trauma). A comorbid condition required a clinical diagnosis or event to be compatible with the timing of unacceptable outcome (e.g. worse outcome after trauma). Cases without an identifiable alternative explanation for an ODI>22 were categorised as lumbar condition.

Assignment to the lumbar-condition or comorbid-condition category was based on (1) prospectively collected clinical data from physiotherapist-patient contact at ≥2 months, (2) spinal and hospital consultant letters (private patients), (3) local NHS hospital trust subspeciality clinical letters and imaging (NHS patients), (4) diagnostic imaging at the centre (all patients), and (5) patient self-initiated explanations on paper PROM questionnaires. Categorisation was reached via consensus between the clinically embedded lead researcher and the operating consultant and, for NHS cases, with the NHS orthopaedic registrar and resident doctor who reviewed NHS databases.

Hospital metrics included operative time, perioperative adverse events, and postoperative length of stay, rehabilitation, lower-limb arthroplasty, and lumbar MRI and injections. Hospital metrics were prospectively collected by hospital spinal audit and governance teams and retrospectively checked against databases. The effect of postoperative lower-limb arthroplasty on PROM was evaluated.

Continuous variables were compared using independent-samples t-tests, paired t-tests, or analysis of variance; categorical variables were compared using Chi-squared tests. The hazard function was calculated using the Kaplan-Meier method with differences assessed by the log-rank statistic, with the number at risk calculated using the date of last clinical review, PROM, or radiological database entry. We updated a

previously validated ODI model with data from 01/01/2008 to 30/06/2025 [21] . The ODI model, in brief, used a general linear model with 12-month ODI as the dependent variable and baseline PROM and characteristics as independent variables (Supplementary Fig. I).

We compared baseline characteristics and outcome metrics between the acceptable-disability, lumbar-condition, and comorbid-condition groups. Loss-to-follow-up sensitivity analysis compared baseline characteristics, ODI model and PROM scores, and applicable outcome metrics of ODI responder groups: ODI non-responders, last ODI at 3 months, and 12-month ODI responders. Baseline characteristics, comorbid diagnoses, and outcome metrics of last ODI at 3 months were assessed against 12-month ODI results.

Ethics approval was obtained from the XXXX Hospital and XXXX Hospital Audit and Governance Committees (Spine_CS_26-27_A01). Statistical significance was defined as $p \leq 0.05$, based on a two-sided hypothesis test with no adjustment for multiple comparisons. To reduce bias from multiple small-group analyses, only variables with $n \geq 10$ were discussed. A priori sample size analysis was not performed. Statistical analysis was performed with SPSS v31.0 (IBM Corp., Armonk, NY, USA).

Results

Figure 1 shows the inclusion of 3,432 in the 2008–2025 ODI model and 1,524 in the 2020–2025 primary study, together with the clinical sources used for disability classification. In the primary study, 12-month ODI was available for 78.3% (1193/1524). Twelve-month disability was acceptable (ODI≤22) in 56.9% (679/1,193), whilst ODI>22 was attributed to lumbar conditions in 30.5% (364/1,193) and comorbid conditions in 12.6% (150/1,193).

Table 1 presents baseline characteristics by ODI category with comparison of the three ODI categories. Comparison of acceptable disability with each condition category found that age (p<0.001), procedure (p<0.001), and previous lower-limb arthroplasty (p=0.015) were associated only with the comorbid-condition group, whereas BMI (p=0.002) and previous lumbar surgery (p<0.001) were associated only with the lumbar-condition group.

Table 2 presents perioperative PROMs by ODI outcome category, including comparison between the lumbar-condition and comorbid-condition groups. At 12 months, the lumbar-condition group had consistently poorer back pain than the comorbid-condition group (p<0.001). PROMs differed across the three ODI outcome categories (all p<0.001).

Table 3 shows comorbid diagnoses, of which the most prevalent was lower-limb OA. Lower-limb OA was also the most prevalent diagnosis in cases with multiple conditions (Table 3 footnote).

Table 4 presents hospital and healthcare metrics by ODI category with comparison of the three ODI categories. Comparison of the lumbar-condition and comorbid-condition groups found that the comorbid-condition group had a higher rate of lower-limb arthroplasty referral than the lumbar-condition group (p<0.001), whereas the lumbar-condition group had a higher rate of 12-month lumbar injection (p=0.004) and MRI (p<0.001) than comorbid condition. Figure 2 presents 18-month lumbar MRI Kaplan-Meier curves by 12-month ODI category.

193

194 **Postoperative lower-limb arthroplasty**

195 Within 12 months of lumbar surgery, 1.6% (24/1524) underwent hip (*n*=19) or knee
196 (*n*=5) arthroplasty for degenerative conditions. Arthroplasty was performed 212 (SD
197 82) days after lumbar surgery. At 12 months, a further 2.6% (40/1524) awaited hip
198 (*n*=17) or knee (*n*=23) arthroplasty.

199

200 Table 5 presents perioperative PROMs for patients referred for lower-limb arthroplasty
201 after lumbar surgery. All PROMs improved between baseline and 3 months (all
202 $p \leq 0.039$). ODI and EQ-5D improved further between 3 and 12 months when hip
203 arthroplasty was performed before 12 months. ODI and EQ-5D worsened between 3
204 and 12 months in groups awaiting hip or knee arthroplasty at 12 months.

205

206 Within 12 months of lumbar surgery, 0.2% (3/1524) had arthroplasty for hip fracture.

207

208 **ODI model**

209 Complete baseline data capture for the 01/01/2008–30/06/2025 ODI model was
210 available in 97.5% (3346/3432), with a 72.1% (2412/3346) 12-month follow-up rate.
211 Baseline characteristics and ODI model are presented in, respectively, Supplementary
212 Table I and II.

213

214 **Loss to follow-up analysis**

215 Comparison of responder group baseline characteristics, PROMs, and hospital metrics
216 are presented in, respectively, Supplementary Table III, IV, and V. ODI non-responders
217 were younger, had higher baseline disability, and had a higher prevalence of
218 anxiety/depression and smoking. Supplementary Fig. II presents 18-month lumbar MRI
219 Kaplan-Meier curves by ODI response status.

220

221 Baseline characteristics, PROMs, comorbid diagnoses, and hospital metrics for the last
222 ODI at 3 months cohort are presented in Supplementary Tables VI, VII, VIII, and IX,
223 respectively. Last ODI at 3-month results were similar to 12-month ODI results but did
224 not support the association of comorbid condition with <30-day unplanned hospital
225 readmission.

226

227 A total of 3.6% (12/331) of 12-month ODI non-completers self-initiated contact to inform
228 us that comorbid condition(s) prevented accurate or fair ODI evaluation.

229

Discussion

This study found that comorbid conditions account for a substantial proportion of cases with unacceptable disability following lumbar surgery. The most frequent comorbid condition was symptomatic lower-limb joint OA, while multiple conditions and 17 other categories comprised the remainder. We discuss the findings' impact on perioperative care, postoperative diagnosis, and PROM interpretation.

Lumbar and comorbid conditions had similar disability risk factors at baseline, indicating most risk factors predict all-cause disability. In agreement with others, preoperative higher disability, smoking, anxiety/depression, prolonged leg pain duration, female sex, ASA class 3, and inflammatory disease were associated with postoperative disability [22, 23]. However, preoperative lower-limb arthroplasty was associated only with postoperative disability related to comorbid conditions, particularly lower-limb OA. Similarly, previous lumbar surgery only predicted lumbar-related disability. Other factors may be condition-specific predictors; for example, MRI lumbar multifidus parameters may only predict lumbar condition due to the link between multifidus and lumbar function [24]. Overall, our findings indicate that disability prediction tool results are communicated to patients as predictions of disability rather than its cause. Perioperative care should take a holistic approach towards risk factors to help prevent or delay the onset of all-cause disability.

Determining the aetiology of postoperative disability remains a clinical challenge. Neither the ODI nor a single diagnostic test can definitively differentiate disability caused by a lumbar or comorbid condition [8]. In this study, comorbid condition diagnosis was predominantly (75%, 135/181) based on spinal or other specialist clinical examination and further investigation or treatment. The remaining comorbid diagnoses were from physiotherapist-patient data or patient self-report (e.g. trauma, etc.) in the absence of countervailing clinical information. Postoperative variability in symptoms also presents a challenge in identifying the cause of disability. Of 1119 with 3- and 12-month ODI, 25.0% (280/1119) changed disability categories (acceptable, lumbar condition, to/from comorbid condition) between follow-ups, including 11 that transitioned between lumbar-condition and comorbid-condition disability. As approximately one-third of unacceptable disability cases lacked a late-stage

diagnostic workup, this study likely underestimates the true prevalence of comorbid-related disability. To improve outcomes, providers must facilitate timely specialist referral for differential diagnosis and treatment when required. Additionally, spinal registers should allow clinicians to formally attribute poor PROM scores to symptomatic comorbid conditions.

Our findings confirm that concurrent lower-limb OA is prevalent in an ageing spinal population and spinal PROMs are influenced by postoperative lower-limb arthroplasty [13, 14]. In our cohort, 4.2% (64/1524; 70.4 years (SD 8.4), 55% female, 25% previous lower-limb arthroplasty) had a postoperative lower-limb arthroplasty or awaited arthroplasty at 12 months. Importantly, disability and quality of life improved between 3 and 12 months in patients who underwent postoperative arthroplasty but worsened in cases still awaiting lower-limb arthroplasty at 12 months. Half (32/64) of the postoperative arthroplasty cases had a preoperative record of clinically significant lower-limb OA. In the remaining cases, OA symptoms became more clinically evident after lumbar surgery, possibly due to symptoms initiated or exacerbated by increased postoperative activity. For patients with OA symptoms, targeted exercise programs and self-management strategies are recommended.

Comorbid conditions also confound the comparison of performance. At the healthcare provider level, public-funded healthcare was an independent associated factor for disability (Supplementary Table II). However, comorbid condition prevalence was an absolute 7.0% higher in public than private patients (p=0.006). Hence, poorer public healthcare outcomes could be partly explained by the higher burden of comorbid conditions. Similarly, to enable valid comparisons at the national, hospital, and consultant levels, surgical outcome analyses should control for comorbid condition prevalence and treatment. At the consultant level, comorbid condition data would also help improve PROM interpretation and facilitate reflection on clinical practice.

Comorbid conditions may contribute to patients' nonresponse to PROMs. To enhance data integrity and response rates, national registries should invite patients to disclose whether their symptoms are influenced by a postoperative event or diagnosed coexisting health condition. Currently, one register includes a patient-reported

297 experience measure (PREM) question on gaining ‘new comorbidities postoperatively’
298 but does not assess the impact of the condition on current symptoms [25]. A refinement
299 to the PREM question is suggested in Table 6.
300
301 **Limitations**
302 A single-centre study has inherent limitations. As this cohort was not cross-referenced
303 with national arthroplasty registry databases, the incidence of lower-limb arthroplasty
304 procedures may be under-reported. Our 0.4% (5/1409) prevalence of mental disorders
305 was low compared to 3.0% reported by Ballatori, et al [12]. Implementation of a
306 structured postoperative mental health screening within 3 months may have captured
307 missed new-onset psychiatric transitions that occur mostly in the early postoperative
308 phase [12]. Postoperative investigations performed by external providers were not
309 systematically captured, potentially introducing bias. However, our centre and affiliated
310 public hospital routinely import external imaging data, thereby reducing the risk of
311 sampling bias. Loss to 12-month follow-up was 22%, but sensitivity analysis showed
312 the main findings are robust.
313
314 **Conclusion**
315 Comorbid conditions represent over 29% of cases with unacceptable disability after
316 lumbar surgery. Timely access to specialist review is a key component of differential
317 diagnosis. Identifying symptomatic comorbid conditions is necessary for accurate
318 PROM interpretation at the national, hospital, and individual consultant levels.
319

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Figures

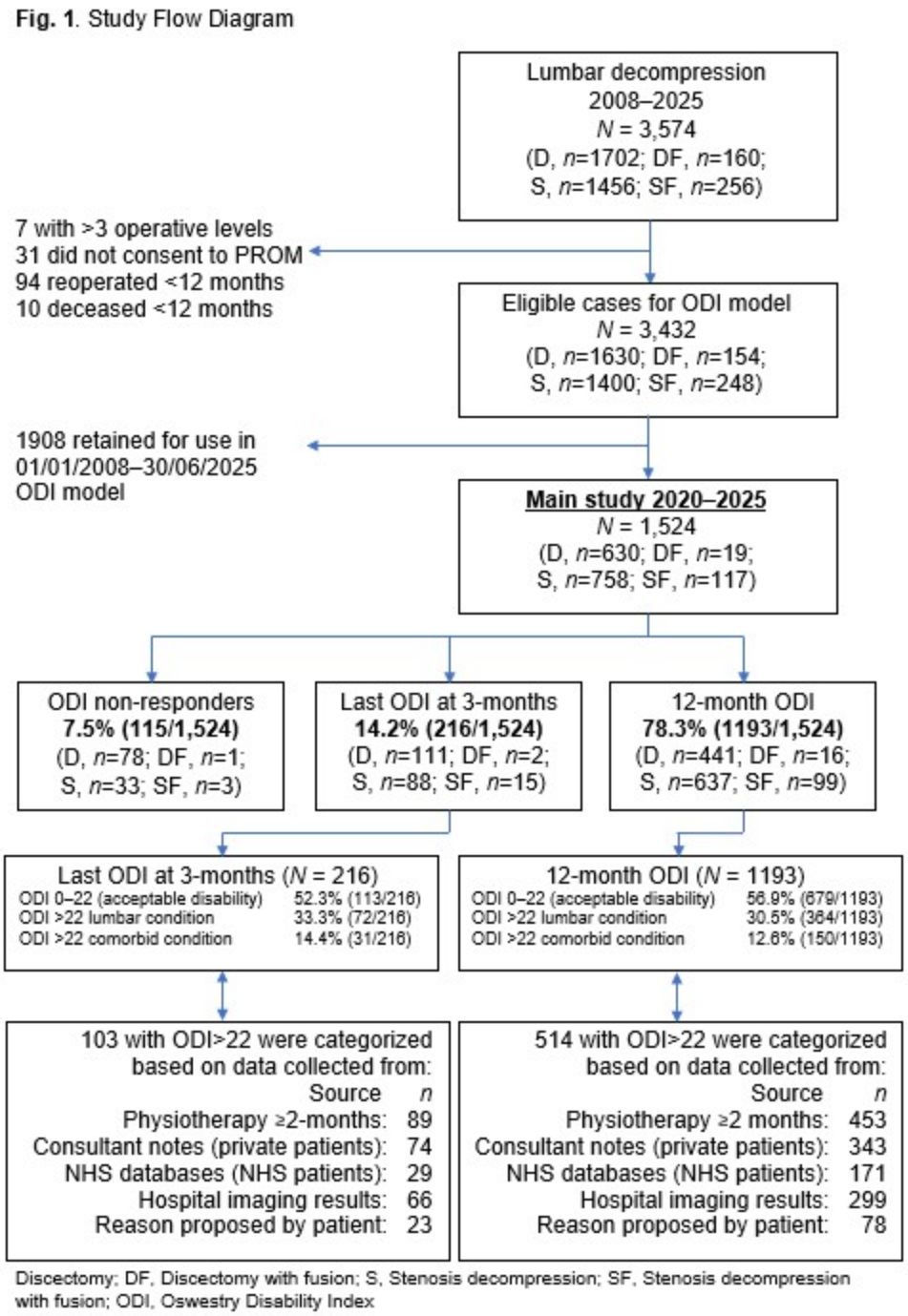


Figure 1

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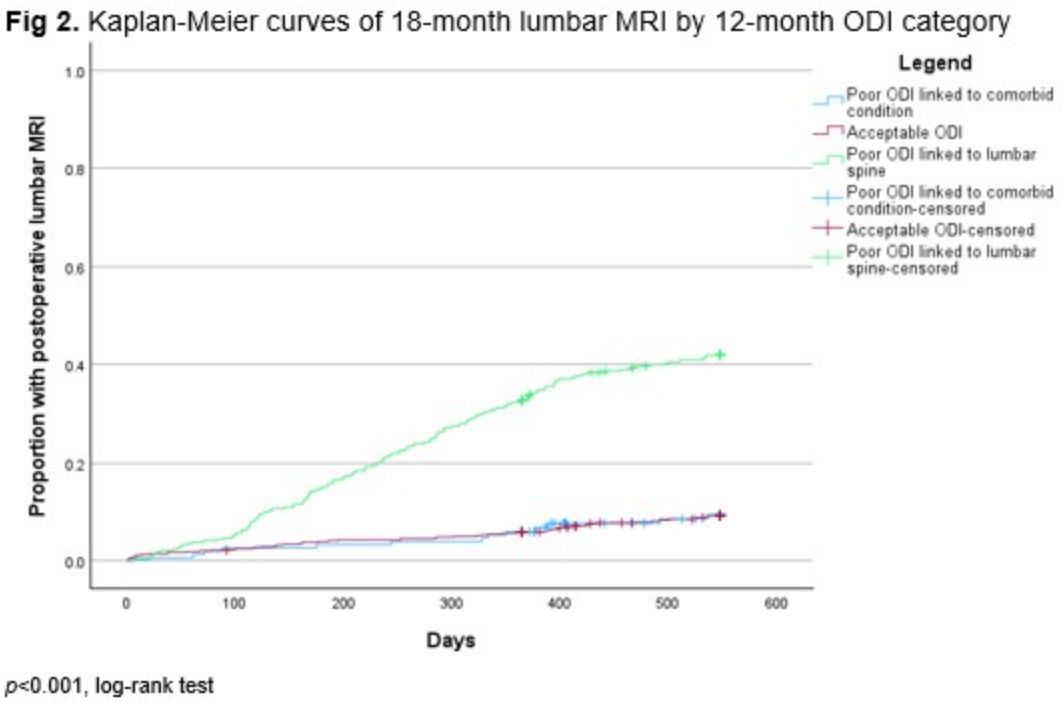


Figure 2

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