Measuring quality of recovery (QoR-15) after degenerative spinal surgery: A prospective observational study

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ABSTRACT

Introduction: The Quality of Recovery (QoR-15) score evaluates patient's recovery after surgery and anesthesia. There is a lack of studies focusing on the patients' quality of recovery in the early post-discharge phase after elective lumbar spine surgery.
Research question: We aimed to identify the QoR-15 score in patients who underwent surgery for degenerative low back conditions. Furthermore, we aimed to identify the individual items of the QoR-15 that are crucial for the patients' quality of recovery.
Material and methods: The study was conducted at a spine center in Denmark from December 2021 to September 2022. Data were collected, using a mobile health application, preoperatively and at 3 time points after hospital discharge. Descriptive analysis followed by within-subjects longitudinal repeated measures was conducted. The individual items of the QoR-15 score were explored using a heatmap.
Results: Data from 46 patients were analysed. The mean QoR-15 sum score at baseline was 105.4 ± 18.3. The mean QoR-15 sum scores were 108.1 ± 19.2 on post-discharge day 1, 118.5 ± 17.4 on day 7, and 120.7 ± 20.9 on day 14. The mean QoR-15 score from day 1 to day 7 improved significantly. Eight of the 15 items influenced the overall QoR-15 score.
Discussion and conclusion: This study applied the QoR-15 score in lumbar spine surgery patients. We identified specific items from the QoR-15 scale that are crucial to improving patients' recovery after hospital discharge. Further research is needed to identify specific needs in the post-discharge period in this group of patients.

1. Introduction

Patient-reported outcome measures (PROMs) are increasingly used to assess the effectiveness of treatments (Black, 2013). PROMs in spine surgery commonly include self-report generic health-related quality-of-life questionnaires such as the EuroQol-5 Dimensions (Herdman et al., 2011) and the 36-Item Short Form Health Survey (Ware and Sherbourne, 1992), as well as disease-specific functional outcome measures, including the Oswestry Disability Index (Fairbank et al., 1980). PROMs are traditionally administered at 6, 12 and 24 months after surgery and compared to baseline to evaluate treatment effectiveness. However, there is a lack of studies focusing on the patients' quality of recovery in

the early post-discharge phase immediately after spine surgery.

To measure the quality of recovery from the patient's perspective, a frequently used tool is the 15-item quality of recovery (QoR-15) scale (Myles et al., 2022). The tool comprises 15 questions within 5 dimensions: pain, physical comfort, physical independence, emotional status and psychological support (Stark et al., 2013). The psychometric properties of the QoR-15 scale include good validity, reliability, responsiveness and clinical acceptability in surgical populations. Furthermore, the burden on the patients is minimal, since most patients can complete the questionnaire in only a few minutes (Stark et al., 2013; Kleif et al., 2018). Patients' responses on the QoR-15 make it possible to assess the recovery of the individual patient and are useful for planning

healthcare interventions in the immediate postoperative phase (Kleif and Gögenur, 2018).

Providing essential support for patients discharged shortly after surgery is crucial given their independent post-discharge period. A comprehensive understanding of their well-being is paramount, enabling targeted and effective interventions to optimise their recovery trajectory. Therefore, the objective of this study is to measure the quality of recovery (QoR-15-score) in patients who underwent elective spinal surgery for degenerative low back conditions. We also sought to identify the individual items of the QoR-15 that need particular attention among patients undergoing surgery for degenerative disorders in the lumbar spine to develop a personally tailored intervention to support their immediate post-discharge recovery. Finally, this study aimed to assess whether a mobile health application is suitable for collecting the type of data used.

2. Methods

The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement (von Elm et al., 2007) was used as a guideline for reporting this study.

2.1. Study design

This is a prospective observational study. The research is part of phase I of a 3-phase participatory design study aimed at optimizing the post-discharge patient journey following surgery for degenerative disorders in the lumbar spine (Simonsen and Robertson, 2013; Clemensen et al., 2007). In this initial phase, the focus is on identifying patient needs and preferences to inform the design and development of a solution in phase II. Subsequently, the new solution will be tested and evaluated in the third and final phase (Clemensen et al., 2007). The results from the current study will be complemented by results from a qualitative study exploring patients' needs and preferences through focus group interviews and patient diaries. These results will be published separately.

2.2. Setting and participants

The study was conducted at a single spine centre, which is part of a medium-sized hospital in Denmark. Patients were included consecutively in the spine surgical outpatient ward during the admission interview with the nurses. Eligible for inclusion were patients aged 18+ who were scheduled for surgery for degenerative disorders in the lumbar spine, including discectomies, spinal decompressions and spinal fusions. Patients were excluded if they could not or were not interested in filling out a digital questionnaire in Danish.

At our facility, patient admission occurs on the day of the surgical procedure. Individuals undergoing lumbar discectomy or decompression are discharged 1 day after surgery. Conversely, patients undergoing spinal fusion remain hospitalized for 4.25 days on average. In instances of perioperative complications, such as dural tears or nerve root injuries, the duration of hospitalization may be prolonged.

2.3. Data collection and data sources

Data were collected from December 2021 to September 2022. Patient demographics and perioperative information were obtained from the national database of spine surgery, DaneSpine (Andersen et al., 2021; Simony et al., 2014). The Danish version of the QoR-15 (Kleif et al., 2015) was converted to a digital version by the first author [MDL], supported by the Information Technology department at the hospital. Data were collected using a health application accessible via a smartphone, tablet or computer (CIMT. My Hospital). Each of the 15 items of the QoR-15 questionnaire was answered on an 11-point numerical rating scale from 0 to 10. The total score ranges from 0 to 150, with a higher

score indicating a better QoR (Stark et al., 2013). We performed measurements using the QoR-15 at 4 separate time points. The questionnaire was sent out to the patients 4 days before surgery (baseline) and on day 1 (D1), day 7 (D7) and day 14 (D14) after discharge. A digital reminder followed all questionnaires if the patients had not answered the primary questionnaire within 24 h.

2.4. Statistical analysis

Descriptive analysis was performed using IBM SPSS Statistics for Windows (Version 28.0. Armonk, NY: IBM Corp.). Data in text and graphs are shown as mean $\pm$ standard deviation (SD) if not indicated otherwise. A p-value ≤ 0.05 was considered statistically significant.

To investigate change over time in QoR-15 sum scores, a within-subjects longitudinal repeated measures analysis was performed. Estimated marginal means for all time points of measurement were calculated and presented in a profile plot, including 95% confidence interval error bars. The significance of change over time was evaluated with pairwise comparisons.

To elucidate the contribution of each item on the QoR-15 sum score, a heat map was produced to visualise data in 2 dimensions by supplementing the numeric values with a colourized indication of magnitude. In the colour scheme used, red RGB(248,105,107) represents a numeric value of 0, yellow RGB(255,235,132) the median of 5 and green RGB (99,190,123) the numeric value of 10. Variations from 0 to 10 are reflected by colour hue and intensity.

The completion rate, defined as the percentage of patients who initiated participation and completed the entire questionnaire at all time points (Westenberg et al., 2020), was used to assess the suitability of using a health application for data collection.

2.5. Ethical considerations

The study complies with the ethical standards from the Declaration of Helsinki (World Medical Association, 2013). All participants received written and oral information and gave their consent before participation. The processing of personal data was submitted to and approved by the Region of Southern Denmark and listed in the internal record (File no. 21/32183). Ethical approval was obtained from the local institutional review board. The study was presented to The Regional Committees on Health Research Ethics for Southern Denmark but was deemed to be exempt from review (File no. S-20212000-95 and Acadre 21/209).

3. Results

3.1. Baseline characteristics of the participants

A flowchart of the data collection is presented in Fig. 1. Sixty-eight of the possible 92 patients (74%) completed the pre-operative baseline questionnaire. Data from 46 patients were analysed, including 20 females and 26 males, who completed the QoR-15 score at baseline and all three post-discharge time points. Baseline demographics for the patients are presented in Table 1.

The mean age of the patients was 50.1 ± 11.2 years. The majority of the patients had one-level surgery (84.8%) and first-time spine surgical treatment (82.6%). Fourteen patients (30.4%) underwent spinal fusion surgery. Two patients (4.5%) experienced dural tears during their surgery. Neither of these led to prolonged hospital stays.

3.2. Quality of recovery (QoR-15) score in patients who underwent degenerative spinal surgery

The mean QoR-15 sum score and range at baseline were 105.4 ± 18.3 (range, 64–143). The mean QoR-15 sum scores and ranges were 108.1 ± 19.2 (range, 66–147) at D1, 118.5 ± 17.4 (range, 67–147) at D7
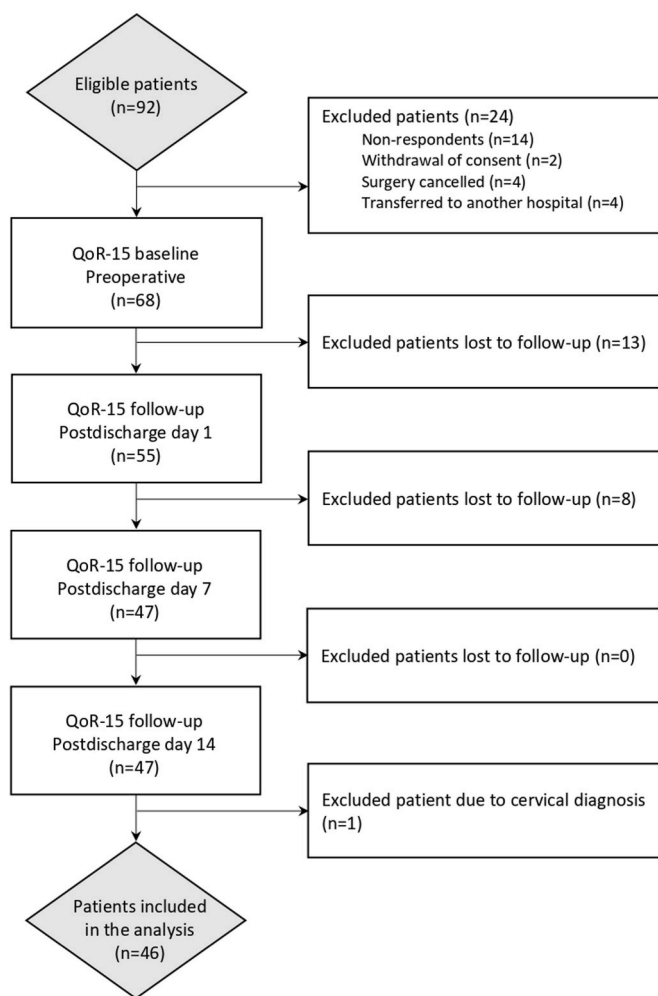
Fig. 1. Flowchart of the data collection.

Table 1
Baseline demographics for the participants.

Characteristics	Numeric value
Number of patients, (n)	46
Age, years, mean (SD)	50.1 (11.3)
Gender, females, n (%)	20 (43.5)
Smoker, n (%)	7 (15.2)
BMI, mean (SD)	27.9 (3.7)
Previously operated, n (%)	8 (17.4)
Surgery at no. levels: One level, n (%)	39 (84.8)
Two levels, n (%)	6 (13.0)
Three levels, n (%)	1 (2.2)
Leg pain duration: No pain, n (%)	1 (2.2)
< 3 months, n (%)	8 (17.4)
3–12 months, n (%)	21 (45.7)
1–2 years, n (%)	9 (19.6)
> 2 years, n (%)	7 (15.2)
Back pain duration: No pain, n (%)	3 (6.5)
< 3 months, n (%)	5 (10.9)
3–12 months, n (%)	15 (32.6)
1–2 years, n (%)	8 (17.4)
> 2 years, n (%)	15 (32.6)
Functional impairment (ODI), mean (SD)	38.1 (14.6)
VAS: Leg pain, mean (SD)	59.8 (27.3)
Back pain, mean (SD)	49.3 (29.4)
Quality of life (EQ-5D-3L), mean (SD)	0.474 (0.304)
SF-36: Physical Component Score, mean (SD)	33.0 (7.4)
Mental Component Score, mean (SD)	48.1 (12.2)
Complications Dural tears, n (%)	2.0 (4.5)
Nerve root injury n (%)	0.0 (0.0)
QoR-15 sum score: Preoperative, mean (SD), range	105.4 (18.3), 64-143
Day 1 mean (SD), range	108.1 (19.2), 66-147
Day 7, mean (SD), range	118.5 (17.4), 66-147
Day 14, mean (SD), range	120.7 (20.9), 43-150

ODI, Oswestry Disability Index.
SD, standard deviation.
SF-36, 36-Item Short Form Survey.
VAS, visual analogue pain scale.

and 120.7 ± 20.9 (range, 43–150) at D14 (Table 1).

The mean QoR-15 sum score change over time is presented in Fig. 2.

Pairwise comparisons of the mean QoR-15 sum score at each of the different time points showed a significant improvement in the mean QoR-15 sum score from baseline to D7 (mean difference (MD) 13.00, SD 2.53 [95% CI, 7.91–18.09]; $P < 0.001$), baseline to D14 (MD 15.13, SD 2.81 [95% CI, 9.48–20.78]; $P < 0.001$), D1 to D7 (MD 10.44, SD 2.55 [95% CI, 5.29–15.58]; $P < 0.001$) and D1 to D14 (MD 12.57, SD 2.98 [95% CI, 6.56–18.57]; $P < 0.001$). There were no significant changes in the mean QoR-15 sum score from Baseline to D1 (MD 2.57, SD 2.45 [95% CI, $-2.37 - 7.50$]; $P = 0.301$) or from D7 to D14 (MD 2.13, SD 2.06 [95% CI, $-2.03 - 6.29$]; $P = 0.307$).

3.3. QoR-15 items scores visualised in heatmaps

According to the heatmap of the mean QoR-15 items (Fig. 3), 7 of the 15 individual items do not appear to have relevance to the patients' quality of recovery at any time in the immediate post-operative recovery phase. These include: (1) Able to breathe easily, (2) Been able to enjoy food, (5) Able to look after personal toilet and hygiene unaided, (6) Able to communicate with family and friends, (7) Getting support from hospital doctors and nurses, (13) Nausea or vomiting and (15) Feeling sad or depressed. Two items were consistently a concern: (11) Moderate pain and (8) Able to return to work or usual home activities. Although (14) Feeling worried or anxious was a major concern before surgery; it was less so on D1, D7 and D14. Five items were a concern before surgery and at D1: (3) Feeling rested, (4) Have had a good sleep, (9) Feeling

comfortable and in control, (10) Having a feeling of general well-being and (12) Severe pain was a concern prior to surgery and on D1; they were less so on D7 and D14.

3.4. Completion rate

The QoR-15 score was assessed at all four time points in 46 of 68 possible participants. This corresponds to a completion rate of 67.6%.

4. Discussion

The QoR-15 tool is frequently used to examine the quality of recovery within different types of surgery (Myles et al., 2022; Kleif et al., 2018; Wessels et al., 2022). However, this prospective observational study is the first study to measure the quality of recovery (QoR-15) score in patients who underwent surgery for degenerative disorders in the lumbar spine.

This study showed a significant improvement in the mean QoR-15 score from D1 to D7. This indicates that patients can anticipate the most substantial enhancement in their quality of recovery during the period from day 1 to day 7 post-discharge, with subsequent progress exhibiting a more modest incline beyond this first week. This information allows healthcare providers to appropriately counsel patients on expectations regarding time to recovery after lumbar spine surgery.

According to Kleif and Gögenur (2018), patients can be classified as being in poor, moderate, good or excellent recovery, based on the QoR-15 score. The range values in this study showed a representation of patients within all of the 4 severity classes during each of the time points of the data collection period. This underlines the need for future interventions aiming to support the patients' post-discharge recovery, to be tailored to the individual patient.
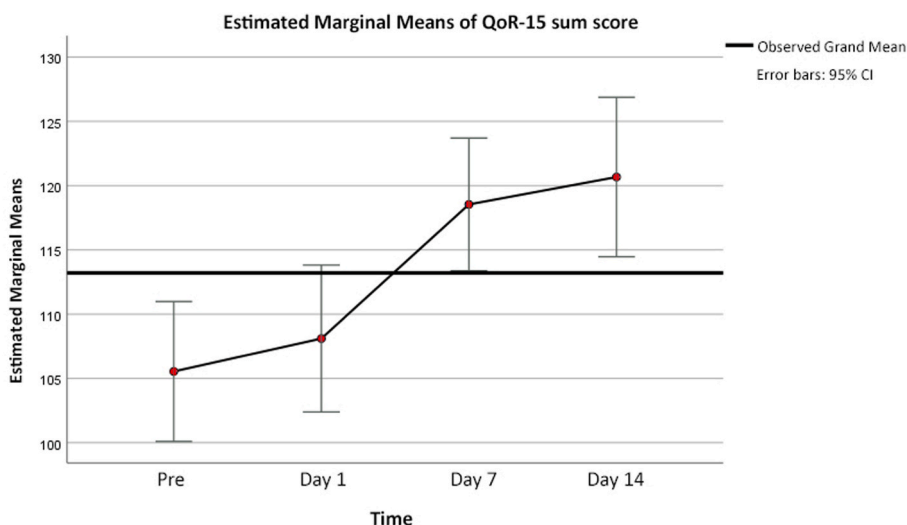
Fig. 2. Mean QoR-15 sum score change over time.

QoR-15 items	Pre n = 46	Day 1 n = 46	Day 7 n = 46	Day 14 n = 46
1. Able to breathe easily	9,0	9,3	9,7	9,4
2. Been able to enjoy food	9,3	8,9	9,3	9,4
3. Feeling rested	6,3	5,9	6,9	7,4
4. Have had a good sleep	6,3	6,4	7,4	7,4
5. Able to look after personal toilet and hygiene unaided	8,7	8,0	9,0	8,7
6. Able to communicate with family and friends	9,2	9,2	9,7	9,7
7. Getting support from hospital doctors and nurses	8,1	9,0	8,7	9,2
8. Able to return to work or usual home activities	5,2	3,2	4,6	5,7
9. Feeling comfortable in control	6,6	6,0	6,9	7,5
10. Having a feeling of general well-being	6,1	6,5	7,1	7,5
11. Moderate pain	4,1	4,5	5,7	6,1
12. Severe pain	5,2	6,6	7,4	7,6
13. Nausea or vomiting	8,2	8,6	9,3	8,9
14. Feeling worried or anxious	6,4	7,7	8,1	8,0
15. Feeling sad or depressed	7,4	8,6	7,9	8,1

Fig. 3. Heatmap of the mean QoR-15 items.

Participants in a study by Wessel et al. (Wessels et al., 2021), reporting on the QoR-15 score in patients following elective and semi-urgent orthopaedic surgery including hand/arm, shoulder, foot/-ankle, hip and knee surgery, had higher baseline QoR-15 scores compared to the spine surgery patients in our study. Similarly, Brusco et al. (2022) measured a higher baseline QoR-15 score in their sample of 514 patients with a broad range of elective surgeries, which required overnight stay admissions, in a multicentre study in Australia. These findings show that there are more concerns to address, in this regard, for patients undergoing lumbar spine surgery compared to patients undergoing other types of orthopaedic or elective surgeries. Again, this emphasizes the need to proactively provide support to patients in the early post-discharge recovery phase after lumbar spine surgery.

In this study, we also identified the individual items of the QoR-15 that need to be specifically addressed for patients undergoing elective spine surgery for low back conditions. The heatmap of the QoR-15 item scores provided us with an effective visual summary and instant communication of the data. We easily identified which items to focus on in a future intervention to support the patients' post-discharge recovery. Based on this finding, we recommend focusing on patients' experiences of pain, sleep, activity and rest. Furthermore, the results allow for pre-operative counselling to address patient concerns and anxiety before surgery.

4.1. Strengths and limitations

This study has some limitations. A power calculation was not conducted, as this is not an intervention study. Given the scope of our research and the resources available, this study was performed as a single-centre study, which potentially entails limited external validity (Bellomo et al., 2009). Hence, the generalisability of the results may be limited to patients with characteristics similar to those of the sample included in the study.

In a systematic review, Meirte et al. (2020) identified conflicting

findings regarding the impact of electronic data collection versus traditional paper format on response rates. This study's 67.6% completion rate indicates that using a health application for data collection can be a useable approach (Fincham, 2008). However, the relatively high number of non-responders indicating that around 30% will be lost to follow-up, should be taken into account in the power calculation for future interventional studies.

Obtaining feedback from non-completing participants could offer valuable insights into specific challenges they faced, aiding in developing targeted interventions to improve the completion rate (Edwards, 2010).

In this study, we did not systematically investigate the reasons for loss to follow-up. However, the observed non-completion rate may be attributed to various factors, including potential discomfort experienced by patients, forgetfulness, or declining interest over the follow-up period. Additionally, the requirement for each participant to complete the same questionnaire 4 times may also lead to respondent fatigue or variations in response quality. Hence, patients participating in this type of investigation must be thoroughly informed about the potential burden imposed by their involvement (Rolstad et al., 2011).

According to Meirte et al. (2020), the use of notifications can improve response rates and compliance. In line with this, it is the authors' opinion, to enhance participation rates, implementing timely and personalised reminders could serve as an effective way to prompt participants for follow-up responses. To reduce the occurrence of loss to follow-up in our future study, we will encourage and guide patients to subscribe to notifications, ensuring they receive reminders when a questionnaire is available. Furthermore, we will provide information about the questionnaire procedures during discharge consultations, aiming to keep it fresh in patients' minds upon returning home from the hospital.

5. Conclusion

This prospective observational study applied the QoR-15 score in patients who underwent surgery for degenerative disorders in the lumbar spine. We identified specific items from the QoR-15 scale that we need to address to improve patients' recovery after hospital discharge. Further research to identify and capture a deeper understanding of the specific needs in the immediate post-discharge period in this group of patients is crucial, as is the design of interventions to address these needs. A mobile health application for data collection can be useful. Nevertheless, future studies are advised to strategically focus on improving the completion rate.

Contributors

MDL, LYC, JC, and MOA were involved in the design of the study. MDL collected the data and wrote the initial draft of the article, excluding the section on statistical analysis. CFP analysed the data and wrote the statistical analysis section. LYC, JC, and MOA reviewed and provided comments in the draft, which MDL subsequently revised. All authors read and approved the final manuscript. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. The authors affirm that the manuscript is an honest, accurate, and transparent account of the study being reported.

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Data availability statement

The data sets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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