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Preoperative Oswestry Disability Index Cannot Reliably Predict Patient Satisfaction After Single and Double Level Lumbar Transforaminal Interbody Fusion Surgery

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Abstract

Introduction: The role of patient-reported outcomes in preoperative assessment is not well studied. There is recent interest in studying whether Patient-reported outcomes scores can be used either independently, or in conjunction with clinical findings, in the assessment of patients for surgery. **Aims:** To investigate if improvement in clinically significant scores correlate with post-operative patient satisfaction in 1-2 level transforaminal lumbar interbody fusion (TLIF) surgery. We also aim to define a threshold Oswestry Disability Index (ODI) which correlate with achieving post-operative MCID and patient satisfaction. **Methods:** 1001 patients who underwent single or double level TLIF (Minimally invasive and Open) in our institution with at least 2 years follow up were included in this study. We studied self-reported measures including patient satisfaction and ODI score. **Results:** At 2-year follow-up, the overall mean ODI score improved from 49.7 ± 18.3 to 13.9 ± 15.2 ($P < 0.001$) with 74.6% of patients meeting the MCID. Patient satisfaction was achieved in 95.3% of all patients. In the MIS group, the preoperative cut-off was determined to be 37.2 at maximal Youden index associated with AUC of 0.72 (95% CI 0.65-0.86). In the open group, the preoperative cut-off was determined to be 37.2 at maximal Youden index associated with AUC of 0.70 (95% CI 0.62-0.77). Using the preoperative cut-offs found, there was no significant difference in patient satisfaction in both MIS and open groups. **Conclusions:** Overall, our patients undergoing TLIF had good 2-year ODI score improvement and patient satisfaction after surgery. While meeting the MCID for ODI score correlates with patients' satisfaction postoperatively, 75% of patients not meeting the MCID for ODI score remained satisfied with the surgery. We are unable to define a threshold pre-operative ODI which correlates with achieving post-operative MCID and patient satisfaction.

Keywords

lumbar, transforaminal lumbar interbody fusion, patient satisfaction, oswestry disability index, outcomes, improvement

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Introduction

Patient-reported outcomes (PRO) are recognized as an independent tool for assessing surgical efficacy.[1,2] Repeated assessments allow surgeons to both quantify an

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objective baseline and to track the patient's progress after surgery. At the patient level, PRO data allow people to understand what to expect during recovery. At the aggregate level, PRO data can be used to compare different surgical procedures to determine which leads to the best outcomes from the patient's perspective.[3]

There is recent interest in studying whether PRO scores can be used either independently, or in conjunction with clinical findings, in the assessment of patients for surgery.[1,4,5] In a study of 217 patients looking at patient satisfaction after transforaminal lumbar interbody fusion (TLIF) surgery, Lim et al. reported that patients with higher preoperative numerical pain rating score for leg pain were more likely to be satisfied at 2 years, despite significant improvement across multiple PRO instruments. It is postulated that patient-reported satisfaction may be chiefly influenced by the improvement of radicular leg pain.[4]

Hwee et al. reported in a study of 292 patients undergoing elective single-level surgery that poorer baseline health scores predict greater improvement in postoperative PRO and recommend its use in decision for surgery and in preoperative counselling. Intuitively, a patient with severe symptoms or disability are more likely to be counselled for surgery.[1]

Against this background, we aim to investigate disability scoring as an adjunct to decision-making in both minimally invasive (MIS) and open transforaminal lumbar interbody fusion (TLIF) surgery by correlating the preoperative Oswestry Disability Index (ODI) to the delta score (2-year endpoint score minus baseline score) and patient satisfaction after surgery. We also investigate if meeting the clinically significant scores correlate with post-operative patient satisfaction in 1-2 level transforaminal lumbar interbody fusion (TLIF) surgery.

Materials and Methods

Prospectively collected institutional registry data was reviewed for all patients who underwent single and double level transforaminal lumbar interbody fusion in a tertiary institution from January 2010 to December 2014. Data from hospital electronic medical records was retrieved to establish patient demographics and individual body mass index (BMI). Preoperative scoring was determined at the point of preoperative evaluation to provide an accurate benchmark for comparison.

Since a general health score may not be sensitive enough, the ODI was chosen as the study instrument of choice because it was developed specific for spine diseases and is among the most widely used disease-specific patient reported outcome in lower back pain.[6,7] The ODI is a 10-item questionnaire with a higher score indicates greater disability.[8] The ODI score for each patient was assessed preoperatively and at the 2-year follow-up. The 2-year mark was chosen as the endpoint because it approximates the time when early rehabilitation potential plateaus with concurrent reduction in the likelihood of an unrelated musculoskeletal event and progression of disease (adjacent segment disease) affecting the ODI score with prolonged follow-up.[9,10]

Patient satisfaction scored at the 2-year follow-up was recorded on a 6-level Likert scale with lower scores indicating greater satisfaction. Patient satisfaction was scored at 2-year follow-up using the question from the North American Spine Society Questionnaire, "How would you rate the overall results of your treatment for back or leg pain?" A score of 4 (fair) or less was considered indicative of patient satisfaction.

The difference in the ODI (delta ODI) after TLIF was compared against its preoperative value. We selected the MCID cut-off to be 14.9. This was adopted from Parker et al. who used an anchor-based minimum detectable change calculation method in determining a TLIF-specific MCID score.[11] Patients who had a delta ODI meeting or exceeding the minimal clinically important difference (MCID) of 14.9 were considered to have a clinically significant improvement following surgery.[5,11] This was used to dichotomize patients into 2 groups characterized as 'responder' and 'non-responder'. Based on the dichotomized MCID outcome as a response, a preoperative ODI cut-off was determined using receiver operating characteristic (ROC) analysis as a diagnostic tool for predicting improvement/no improvement after surgery. Subgroup analysis was performed between patients below and above the preoperative ODI cut-off for both MIS and Open groups to determine differences in patient satisfaction.

95% confidence intervals were calculated for the mean differences. ROC analysis was performed to identify a statistically optimal diagnostic cut-off based on Youden's J-statistic. Differences in means were compared with the Student T-test and proportions with the x^2 test. The SPSS Statistics 21 was used to perform the analysis.

This study was conducted with approval from the SingHealth Centralised Institutional Review Board (Ref 2020/2882) and informed consent was exempted.

Results

1001 patients were included for analysis over the study period of January 2010 to December 2014. Most of our patients were female (64.3%), of Chinese ethnicity (87.8%), and had a mean age of 61.6 ± 10.8 years. At 2-year follow-up, the overall mean ODI score improved from 49.7 ± 18.3 to 13.9 ± 15.2 ($P < .001$) with 74.6% of patients meeting the MCID. Patient satisfaction was achieved in 95.3% of all patients (Table 1). MIS and open TLIF was performed in 595 (59.4%) and 406 (40.6%) patients respectively.

Table 1. Patient Demographics and Outcomes.

Total Patients	N = 1001
Type of surgery (%)	
Minimally invasive	595 (59.4%)
Open	406 (40.6%)
Age (Std. Dev.)	61.6 ± 10.8 years old
Body mass index (Std. Dev.)	25.8 ± 4.3 kg/m^2
Race (%)	
Chinese	851 (85.0%)
Malay	71 (7.1%)
Indian	35 (35.0%)
Others	44 (44.0%)
Preoperative ODI (Std. Dev.)	49.7 ± 18.3
Postoperative ODI (Std. Dev.)	13.9 ± 15.2
Patient satisfaction (%)	
1: Excellent	256 (25.6%)
2: Very good	369 (36.9%)
3: Good	247 (24.7%)
4: Fair	82 (8.2%)
5: Poor	35 (3.5%)
6: Terrible	12 (1.2%)

In the MIS group, 506 (85.0%) patients met the MCID. Patient satisfaction was 99.0% and 77.5% in the responder and non-responder groups respectively ($P < 0.001$). The preoperative cut-off was determined to be 37.2 at maximal Youden index associated with AUC of 0.72 (95% CI 0.65-0.86). This corresponds to a positive predictive value (PPV) of 91.1% and negative predictive value (NPV) of 31.7% (Figure 1). Patient satisfaction was 96.1% and 94.9% in the predicted improvement and predicted no improvement groups respectively ($P = 0.53$).

In the open group, 354 (87.2%) patients met the MCID. Patient satisfaction was 97.5% and 75.0% in the responder and non-responder groups respectively ($P < .001$). The preoperative cut-off was determined to be 37.2 at maximal Youden index associated with AUC of 0.70 (95% CI 0.62-0.77). This corresponds to a PPV of 91.3% and NPV of 25.8% (Figure 1). Patient satisfaction was 94.2% and 95.9% in the predicted improvement and predicted no improvement groups respectively ($P = .52$).

Discussion

Our patients undergoing TLIF have good 2-year outcome score improvement and patient satisfaction. In both MIS and open groups, responders (patients meeting MCID) are almost invariably satisfied after surgery. However, about 3 in 4 non-responders (75%) remain satisfied after surgery. Since a significant proportion of patients remain satisfied despite not having appreciable functional improvement, it follows that functional improvements, though important, is

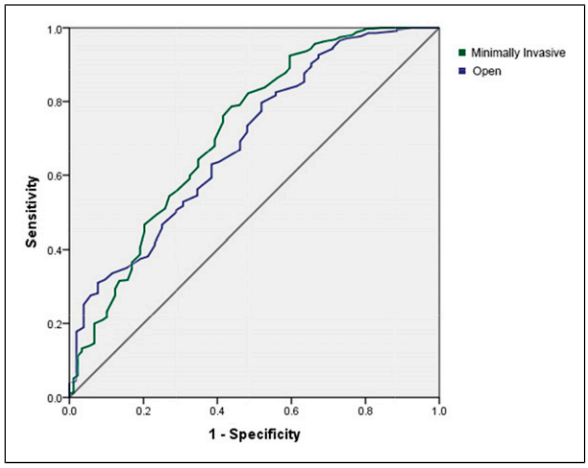

Figure 1. Receiver operating curves for MIS and Open TLIF against patient satisfaction.

not the only significant factor driving patient satisfaction. There may be other yet unrecognised factors driving patient satisfaction in both MIS and Open TLIF. For example, Jenkins et al found postoperative PROMIS physical function scores may be more influenced by back pain than with leg pain.[12] In a retrospective review of patients who underwent surgery for symptomatic lumbar stenosis in Canada, potential predictors affecting recovery have been identified. Patients with higher education level, higher quality of life at baseline, lower baseline disability scores, shorter duration of back pain and lower levels of obesity have been shown to be associated with improved disability outcomes.[13]

The impact of pre-operative mental health on subsequent patient reported outcomes remain controversial in the literature. While Yoo et al showed that patients with worse pre-operative mental health scores had worse postoperative outcomes,[14] other studies have shown poor correlation of baseline mental health with post-surgical patient reported outcome measures.[15-17]

To date, there is paucity of studies in the literature exploring pre-operative disability using established scores such as the ODI and the potential for post-surgical improvements and satisfaction.[18] Although patients with higher disability should intuitively have more 'room' for improvement compared to patients with less disability due to the intrinsic 'ceiling effect', our study showed that preoperative ODI is poorly predictive of postoperative improvement. In fact, in both MIS and open groups, the cut-off value found had no effect on patient satisfaction. We believe that this is because disability arising from lumbar degenerative conditions are multifactorial to begin with. Severe disability could result both from a localised single level disease and from multilevel degeneration. A short segment surgery in this case may alleviate

symptoms but not resolve disability entirely. The chronicity of degenerative conditions can also result in residual neurological deficits complicating recovery after surgery. Since PRO inevitably reduces these clinical conundrums into a single score, it is difficult to account for the varied prognosis after surgery. Another way to interpret this finding would be the potential innate variability of pre-operative disabilities; for example, patients with better mental health may have lower estimates of disabilities.[17]

While MCID in validated indices such as the ODI has been used to compute patient reported outcome scores in value-driven care, they do not completely account for patient satisfaction after surgery. This may lead to under-recognition of benefits derived from TLIF, leading to suboptimal definition of quality in value-derived reimbursement systems.[19] Thus, indications for TLIF needs to be individualised, as evolving factors such as back or radicular pain, patients' co-morbidities and vocation may influence functional recovery or perception of surgical success. Hence, the ODI can only be used as an adjunct in surgical decision making in conjunction with such factors, with clear and mutual understanding of the surgical goals. Further research looking at modifiable predictors such as smoking, physical activity level and obesity could be beneficial in achieving better surgical outcome.

We acknowledge the following limitations. For our study, we chose to focus on type of intervention performed as opposed to a diagnosis-based analysis. Theoretically, patients with different diagnoses may have different prognosis and recovery. However, in practice, the nature of degenerative lumbar diseases is such that patients tend to present with combination of symptoms, rather than isolated spondylolisthesis, degenerative disc disease or facet joint arthritis to begin with.

Second, our patients in both MIS and open groups were not randomised and based on surgeon's preference. We are unable to determine if certain factors or anatomical considerations precludes a patient for MIS surgery. However, the similar outcomes and cut-off calculated suggests that in both groups of patients regardless of approach, TLIF achieved its intended outcome of minimalizing disability and restoring spinal stability in these patients.

Conclusion

Overall, our patients undergoing TLIF had good 2-year ODI score improvement and patient satisfaction after surgery. While meeting the MCID for ODI score correlate with patients' satisfaction post operatively, 75% of patients not meeting the MCID for ODI score remained satisfied with the surgery. We are unable to define a threshold pre-operative ODI which correlate with achieving post-operative MCID and patient satisfaction. Holistic assessment of the individual patient remains crucial in the workup for surgery.

Declaration of Conflicting Interests

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References

1. Hey HWD, Luo N, Chin SY, et al. The predictive value of preoperative health-related quality-of-life scores on post-operative patient-reported outcome scores in lumbar spine surgery. *Global Spine J*. 2018;8(2):156-163.
2. Poh S-Y, Yue W-M, Chen L-TJ, Guo C-M, Yeo W, Tan S-B. Two-year outcomes of transforaminal lumbar interbody fusion. *J Orthop Surg*. 2011;19(2):135-140.
3. Baumhauer JF. Patient-reported outcomes — Are they living up to their potential? *N Engl J Med*. 2017;377(1):6-9.
4. Lim JBT, Yeo W, Chen JLT. Preoperative leg pain score predicts patient satisfaction after transforaminal lumbar interbody fusion surgery. *Global Spine J*. 2018;8(4): 354-358.
5. Matthew JM, Mohamad B, Kristin RA, et al. An analysis from the quality outcomes database, part 1. Disability, quality of life, and pain outcomes following lumbar spine surgery: predicting likely individual patient outcomes for shared decision-making. *J Neurosurg: Spine SPI*. 2017; 27(4):357-369.
6. Carreon LY, Glassman SD, McDonough CM, Rampersaud R, Berven S, Shainline M. Predicting SF-6D utility scores from the Oswestry disability index and numeric rating scales for back and leg pain. *Spine*. 2009;34(19):2085-2089.
7. Teo BJX, Koh JSB, Jiang L, Allen JC, Yeo SJ, Howe TS. Association of the 36-Item Short Form Health Survey Physical Component Summary Score With Patient Satisfaction and Improvement 2 Years After Total Knee Arthroplasty. *JAMA Netw Open*. 2019;2(2):e190062.
8. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. *Physiotherapy*. 1980; 66(8):271-273.
9. Epstein NE. Adjacent level disease following lumbar spine surgery: A review. *Surg Neurol Int*. 2015;6(Suppl 24): S591-S599.

10. Kim EJ, Chotai S, Archer KR, Bydon M, Asher AL, Devin CJ. Need for two-year patient-reported outcomes score for lumbar spine surgery is procedure-specific: Analysis from a prospective longitudinal spine registry. *Spine*. 2017;42(17): 1331-1338.
11. Scott LP, Owoicho A, Alexandra RP, et al. Utility of minimum clinically important difference in assessing pain, disability, and health state after transforaminal lumbar interbody fusion for degenerative lumbar spondylolisthesis. *J Neurosurg: Spine SPI*. 2011;14(5):598-604.
12. Jenkins NW, Parrish JM, Hrynewycz NM, Brundage TS, Singh K. Longitudinal evaluation of patient-reported outcomes measurement information system for back and leg pain in minimally invasive transforaminal lumbar interbody fusion. *Neurospine*. 2020;17(4):862-870.
13. Rowe E, Hassan E, Carlesso L, et al. Predicting recovery after lumbar spinal stenosis surgery: A protocol for a historical cohort study using data from the Canadian Spine Outcomes Research Network (CSORN). *Can J Pain*. 2020; 4(4):19-25.
14. Yoo JS, Hrynewycz NM, Brundage TS, et al. The influence of preoperative mental health on PROMIS physical function outcomes following minimally invasive transforaminal lumbar interbody fusion. *Spine*. 2020;45(4):E236-E243.
15. Goh GS, Liow MHL, Yue WM, Tan SB, Chen JL. Are patient-reported outcomes of minimally invasive transforaminal lumbar interbody fusion influenced by preoperative mental health? *Global Spine J*. 2021;11(4): 500-508.
16. Goh GS, Liow MHL, Yeo W, et al. Patients with poor baseline mental health may experience significant improvements in pain and disability after minimally invasive transforaminal lumbar interbody fusion: A 5-year follow-up study. *Clin Spine Surg*. 2020;33(5):205-214.
17. Mayo BC, Narain AS, Hijji FY, Massel DH, Bohl DD, Singh K. Preoperative mental health may not be predictive of improvements in patient-reported outcomes following a minimally invasive transforaminal lumbar interbody fusion. *Internet J Spine Surg*. 2020;14(1): 26-31.
18. Godil SS, Parker SL, Zuckerman SL, Mendenhall SK, Glassman SD, McGirt MJ. Accurately measuring the quality and effectiveness of lumbar surgery in registry efforts: Determining the most valid and responsive instruments. *Spine J*. 2014;14(12):2885-2891.
19. Crosson FJ, Blonairz K, Glass D, Matthew J. MedPAC's urgent recommendation: Eliminate MIPS, take a different direction. Health Affairs Blog. 2018.