

Trends in the use of patient-reported outcome instruments in neurosurgical adult thoracolumbar deformity and degenerative disease literature

ABSTRACT

Objective: Shifting national healthcare trends place increased emphasis on patient-centered care and value-based outcomes, and thus, patient-reported outcome instruments (PROIs) are often used. We sought to characterize the trends in PROI use over the past decade with regard to thoracolumbar degenerative spine disease and spinal deformity in major neurosurgical journals.

Methods: Articles were screened for PROI use through a PubMed search among five major neurosurgical journals from 2006 to 2016. Articles focusing on adult thoracolumbar deformity and degenerative disease were selected with stringent criteria to further characterize PROI use.

Results: A total of 29 different PROIs were used among 102 articles identified from 2006 to 2016 using our search strategy. *Journal of Neurosurgery: Spine* contained the most articles utilizing PROIs with 35.3% of all articles meeting search criteria. The most frequently used PROIs were Oswestry Disability Index, visual analog scale, and the European Quality of Life Five-dimension questionnaire used in 79.4%, 59.8%, and 29.4% of articles, respectively. Linear regression identified a significant increase in the number of articles employing PROIs from 2006 to 2016 ($Y = 1.85$, $R^2 = 0.77$, $P < 0.01$). The total number of PROIs per article was relatively stagnant over time and did not significantly change ($Y = 0.03$, $R^2 = 0.05$, $P = 0.51$).

Conclusions: PROI use as an outcome tool in the adult thoracolumbar disease literature has increased during the past decade, which may be an indicative of PROI use to define patient expectations. This may also represent a trend toward PROI use as a surrogate measure of value-based care.

Keywords: Deformity, degenerative, neurosurgery, patient-reported outcome, patient-reported outcome instrument

INTRODUCTION


Healthcare is in the mid of a major transition not only in the goals of our efforts but also how care is delivered. This effect may be most largely seen in adult spine disease; for instance, the number of patients seeking spine care increased between 1997 and 2006 from 14.8 million to 21.9, respectively, with an associated expenditure of \$86 billion;^[1] with most recent cost estimates at >\$90 billion.^[2] Spine pathology and low back pain, in particular, are the condition ranked highest in terms of years lived with disability.^[3] A partial explanation to these issues is the functional nature of spine disease, and the bearing treatments have on the quality of life. Conservative and surgical management of spine disease are primarily

aimed at improving functionality and quality of life; thus, properly measuring value in the field is of utmost importance, especially given its significant economic impact in healthcare.^[2] However, measuring “value” is inherently difficult as costs (physical and opportunity), charges, risks, and outcomes are

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key contributing factors.^[4] The patient-reported outcome instruments (PROIs) are increasingly common tools used to objectify patient's outcome data. Outcome measurements are the most important in determining quality as they have bearing on results, rather than process measurements.^[5] The use of PROIs has been explored in multiple ways within spine surgery, however more so within orthopedic surgery.^[6-9] Studies have been undertaken to validate the use of certain PROIs since their use deviates from classical measures used to examine interventional success.^[10] A large proportion of the past spine literature has focused on operative metrics, radiographic outcomes, and physician-produced scales as primary determinants of the successful intervention.^[11] Yet, those measures may not consistently align with functional outcome measures. Together these points raise the question: What constitutes successful management, anatomic correction, or functional improvement? The current trend in healthcare stresses the latter. A perfect example of this trend was a product of the Patient Protection and Affordable Care Act in 2010 and is appropriately dubbed the Patient-Centered Outcomes Research Institute.^[12] In the present analysis, we intend to demonstrate the shifting temperament in outcome measures in the recent neurosurgical thoracolumbar literature as seen by the PROI use.

METHODS

Articles utilizing PROIs as outcome measures were surveyed using a PubMed search. Search terms included "patient-reported outcome," "thoracic," and "lumbar" in conjunction with an attached journal search. Major journals among the neurosurgical literature were used, including *Neurosurgery*, *Journal of Neurosurgery: Spine*, *Spine*, *World Neurosurgery*, and *Neurosurgical Focus*, between 2006 and 2016.

Articles published before September 1st, 2016 were included; values for 2016 were adjusted accordingly by assuming similar article productivity in the last third of the year. As a much more multidisciplinary journal than the remainder, *Spine* was carefully screened to include only articles published from neurosurgical departments. Exclusion criteria included pediatric/adolescent deformity or spine disease, exclusively cervical or sacral involvement, and all articles unrelated to thoracolumbar degenerative or adult deformity disease. Articles were included if they were published between 2006 and 2016, had primary content related to thoracolumbar degenerative or adult deformity disease, and abstract noted PROI use as an outcome measure. Abstracts meeting inclusion and exclusion criteria were screened for PROI use and frequency. PROI use was not confined to merely primary outcome measures. A total of 29 PROIs were identified

between 2006 and 2016. Linear regression analysis was used to determine the frequency of PROI use over time. Descriptive characteristics regarding the use of PROIs were recorded.

RESULTS

Articles were screened among the five selected journals and those meeting all selection criteria included. A total of 102 articles were identified using our search method, and a total of 29 PROIs were utilized [Table 1]. The majority of articles identified were from *Journal of Neurosurgery: Spine* (36; 35.3%) followed by *Neurosurgery* (28, 27.5%), *Spine* (21; 20.6%), *Neurosurgical Focus* (11; 10.8%), and *World Neurosurgery* (6; 5.9%) [Table 2]. The most frequently used PROI was the Oswestry Disability Index (ODI) followed by the visual analog scale (VAS), Europe Quality of Life Five-dimension (EuroQoL-5D) questionnaire, 36-item Short Form Survey (SF-36), and 12-item Short Form Survey (SF-12) [Table 1]. Of all the PROIs recorded, 11 were used once. Linear regression analysis from 2006 to 2016 identified an increase in the use of PROIs in the deformity and degenerative thoracolumbar spine disease literature over time ($R^2 = 0.77$, $P \leq 0.01$) [Figure 1]. Similarly, this trend was accompanied by increasing usage of the ODI over the same period ($R^2 = 0.77$, $P < 0.01$) [Figure 2]. The number of PROIs used per article which met all selection criteria did not drastically change over time ($R^2 = 0.05$, $P = 0.51$).

DISCUSSION

A number of studies have examined PROI trends in the current literature.^[7,9,13] However, most of these efforts have been confined to orthopedics rather than neurosurgery, which is a potential drawback.^[9] There have been limited efforts in analyzing PROI use in neurosurgical literature and,

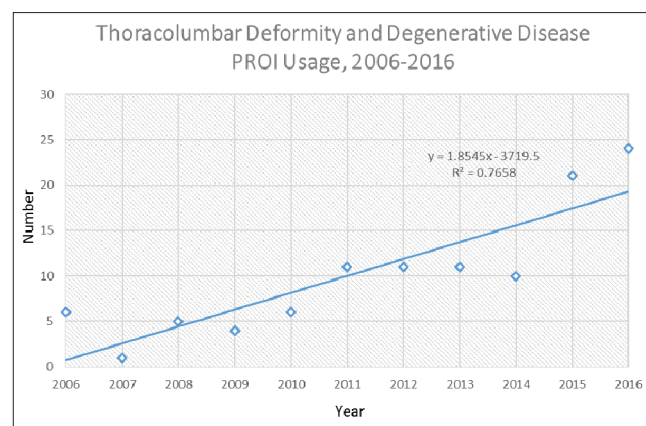


Figure 1: Patient-reported outcome instruments usage trend from 2006 to 2016. The increasing usage of patient-reported outcome instruments over the period from 2006 to 2016

Table 1: Patient-reported outcome instruments used among select neurosurgical Journals from 2006 to 2016

PROI	Uses	Frequency (percentage of total articles)
ODI	81	79.4
VAS	61	59.8
EuroQoL-5D	30	29.4
SF-36	29	28.4
SF-12	15	14.7
SRS-22	12	11.8
NRS, back, and/or leg pain	10	9.8
RMDQ	9	8.8
MacNab criteria [†]	8	7.8
Zung Depression Scale	6	5.9
Patient Satisfaction Questionnaire	6	5.9
Prolo Questionnaire	5	4.9
MSPQ	2	2.0
North American Spine Society Satisfaction Questionnaire	2	2.0
Odom's criteria	2	2.0
Lumbar Stiffness Disability Index	2	2.0
JOABPEQ	2	2.0
Likert scale analogs	2	2.0
Anterior scar-specific patient satisfaction Questionnaire	2	2.0
Swiss Spinal Stenosis Questionnaire	1	1.0
NDI	1	1.0
Likert self-rating scale of global perceived recovery	1	1.0
SF-6D	1	1.0
Zurich Claudication Questionnaire	1	1.0
Sporting activity scale score	1	1.0
McGill pain Questionnaire	1	1.0
ABPI	1	1.0
NCOS	1	1.0
Hopkins rehabilitation engagement scale	1	1.0

[†]MacNab and modified MacNab criteria. PROI - Patient-reported outcome instrument; ODI - Oswestry Disability Index; VAS - Visual analog scale; EuroQoL-5D - European Quality of Life Five-dimension; SF-36-36-item - Short Form Survey; SF-12-12-item - Short Form Survey; SRS-22 - Scoliosis Research Society-22; NRS - Numeric Rating Scale; RMDQ - Roland-Morris Disability Questionnaire; MSPQ - Modified Somatic Perception Questionnaire; JOABPEQ - Japanese Orthopedic Association Back Pain Evaluation Questionnaire; NDI - Neck disability index; SF-6D - 6-Item Short-Form Survey D; ABPI - Aberdeen pain index; NCOS - Neurogenic claudication outcome score

Table 2: Patient-reported outcome instruments use by journal from 2006 to 2016

Journal	n (%)
<i>Journal of Neurosurgery: Spine</i>	36 (35.3)
<i>Neurosurgery</i>	28 (27.5)
<i>Spine</i>	21 (20.6)
<i>Neurosurgical Focus</i>	11 (10.8)
<i>World Neurosurgery</i>	6 (5.9)

to our knowledge, none to examine the trends in use over time.^[14] In the present analysis, we describe and characterize

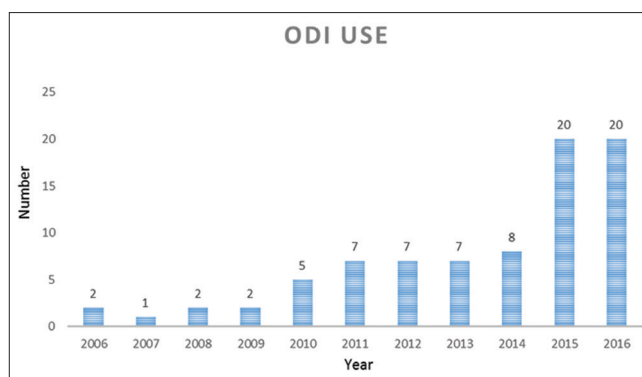


Figure 2: Oswestry Disability Index usage trend from 2006 to 2016 The increasing usage of the Oswestry Disability Index in the selected journals from 2006 to 2016

PROIs use within the neurosurgical thoracolumbar literature from 2006 to 2016. We reveal an increase in the use of PROIs over this period and detail the PROIs most frequently employed, namely, the ODI, VAS, SF-36, EuroQoL-5D, and SF-12. There is an increase in usage of PROIs between 2006 and 2016; however, of studies using PROIs over that time, the number of PROIs used per article is relatively stagnant. While the number of PROIs used per article has remained unchanged, we anticipate that the percentage of published studies choosing to use PROIs as an outcome measure has increased. Secondly, identifying the most frequently used PROIs allows us to focus our efforts on ensuring their validity since they will likely become strong surrogate measures of our operative outcomes.

The ODI was so far the most frequently used measure in our data set. The ODI is scored from 0 to 100 and relates to the level of disability during a series of everyday activities. Importantly, the ODI is a well-validated instrument, and its sensitivity rises with increasing level of pain reported by patients.^[11] While the ODI, VAS, SF-36, and other PROIs were commonly used, 18 of the 29 total PROIs were used twice or less. Improvisation of PROIs limits generalizability.^[9] These data suggest standardization of PROIs is increasingly important for their future benefit. Efforts to validate PROIs before their use have been made.^[15,16] Yet, some instruments are not as rigorously validated which partially explains their less frequent use. In addition, PROIs may either be designated general or disease-specific. The Scoliosis Research Society Outcomes Questionnaire is an example and was used in 11.8% of articles selected. Other disease-specific PROIs include ODI, Roland-Morris Disability Questionnaire (RMDQ), and Japanese Orthopedic Association Back Pain Evaluation Questionnaire. General measures include SF-36, EuroQoL-5D, VAS, and Numeric Rating Scale. Bagó suggests that disease-specific, and even super-specific instruments, may be preferable over generic PROIs.^[17]

Agreeability among PROIs is useful in assessing the value of their use. For instance, the ODI and RMDQ demonstrate moderate level of correlation to the SF-36 over specific factor measures.^[18] Conversely, this study only demonstrated moderate correlation between those three well-accepted PROIs. This thought suggests that less well-accepted PROIs may show minimal correlation which may lead to situations where investigators are capable of “picking and choosing” outcome instruments which demonstrate significance for a given data set. Separately, the SF-6D and EuroQoL-5D (two generic PROIs) are not directly comparable across studies, which suggest that it may be incorrect to compare studies with different PROI outcome measures.^[19] In addition, PROIs may necessitate long-term follow-up for the successful outcome measure. ODI scores at 3-month postlumbar surgery varied largely from ODI at 12 months postoperatively and thus may fail as an early predictor of successful intervention.^[20,21] Still, there are innumerable uses for PROIs, including determining how comorbid conditions may modify patient outcomes postoperatively.^[22]

For PROIs to be successful in practice their implementation and use must be simple and efficient yet descriptive and informative; balancing those aims is difficult and may lead to subpar instrument tools. Greenough made a number of suggestions on optimum PROI usage in practice.^[23] PROIs must be patient-reported rather than collected from independent observers, as the latter is impractical and consumes unnecessary resources. Overly simple PROIs risk blending two components of patient satisfaction, the care process as well as sentiment toward the surgeon (an indirect measure of gratitude) and the actual effect of the treatment on functional outcome.^[23] Distinguishing these two entities is highly important in preserving the integrity and reliability of the PROI. Removing confounding factors from the PROI, such as anxiety and depression, is essential to maintaining their validity as well, examples being the Modified Somatic Perception Questionnaire and Zung Depression Scale.^[24] Streamlining PROI acquisition is vital to efficient record and use of the data; efforts to obtain PROI data through electronic access have been successfully demonstrated.^[25]

The use of PROIs as outcome measures in the primary literature has a number of interesting implications. Their use provokes the question: What is the proper way to determine the success of clinical interventions? There certainly is pressure in the present healthcare climate to ensuring patient-centered, high-value care; however, is increasing PROI use a reaction to this thought or indicative of an actual change in temperament among clinicians? These questions may be further examined with sub-analyses of the

current data. Studying improved PROIs compared to other improved outcome measures and demonstrating associations with complications, operative revisions, and length of stay may suggest PROIs as a surrogate variable in measuring our delivery of healthcare value. In addition, some will argue that the collective literature for PROI use must accompany the entire spine literature, including neurosurgery and orthopedic surgery. However, it seems that neurosurgeons are trailing behind their orthopedic colleagues in acceptance of PROIs as valid outcome instruments as demonstrated by the frequency of PROI use in publication. Yet, this may be more related to differences among the patient populations within the two specialties rather than differences in temperaments. Comparing frequency of PROI use as well as the specific PROIs used often in each specialty assists in unifying the spine literature. Regardless of specialty, it will be important to assess the feasibility of PROI use since in-depth measures with multiple questions, such as the SF-36, may become a burden for analysis compared to other, more objective outcome measures. This is in part an explanation for the development of multiple iterations of PROIs, such as the SF-12 (14.7%) and 6-item Short Form Survey D (1.0%) from their parent instrument.

Limitations exist for the present analysis. Of the articles screened, 102 were found to contain PROI use as an outcome measure from 2006 to 2016. This pales in comparison to values found in the orthopedic spine literature and may be a function of our search strategy.^[9] Thus, the present analysis is intended to be a consistent sampling among the five neurosurgical journals chosen with a single search strategy. Similarly, a search strategy containing the phrase “patient-reported outcome” may be biased since the use of such a phrase may be predated by the instruments themselves.

Nevertheless, the current analysis importantly demonstrates the increasing use of PROIs in thoracolumbar disease and demonstrates those instruments most frequently used among the neurosurgical spine literature. These results validate prevailing thoughts, assess our specialties growth, and demonstrate which instruments may be our most valuable assets when it comes to analyzing patient outcome data in the future since PROIs most frequently used have components in common which lend themselves nicely to patient outcomes. These data act as a springboard to further examine the prevailing attitudes toward value in the current healthcare climate. Understanding our shifting attitude toward outcomes early on helps carry us forward in a more well-defined path. In addition, it calls on all investigators to carefully select outcome tools which are well-validated,

reliable, and fit the clinical questions posed. PROIs can only be as helpful as they are validated and appropriately used.

CONCLUSIONS

We demonstrate an increasing use of PROI use within the thoracolumbar deformity and degenerative disease literature between 2006 and 2016 and also characterize those instruments most frequently used. The increasing use comes at a time where healthcare is undergoing a large shift in how care is delivered and which outcomes are prioritized; the data may suggest a trend toward the use of PROIs as a surrogate of value-based care.

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Conflicts of interest

There are no conflicts of interest.

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