Investigating the influence of locus of control on post-operative spinal surgery outcomes

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Abstract

Study Design. Retrospective, cross-sectional study

Objective. To investigate the relationship between health locus of control and post-operative spine outcomes. Health locus of control is the degree to which one attributes their health to their physician, themselves, chance, and other external factors.

Methods. Retrospective, cross-sectional study including 119 patients treated at the University of Missouri from 2019-2022 was performed. Patients were identified via CPT codes and contacted via phone to complete a validated survey on Health Locus of Control. A multivariate linear model was used to assess the overall statistical significance of domains of locus of control on neck disability index (NDI)/ Oswestry index (ODI) and visual analogue scale (VAS) scores collected.

Results. Higher internal locus scores were associated with lower NDI/ODI scores (p = <0.000). The influence of the internal locus on NDI/ODI was found to have a large effect size. A higher doctor locus of control was associated with lower NDI/ODI scores (p<0.000). The influence of the doctor locus on NDI/ODI was found to have a medium effect. Internal and doctor loci had significant effects on VAS (p<0.000). Higher scores on the internal locus demonstrated significantly lower pain and disability index scores post-operatively.

Conclusions. These finding suggests patients with higher sense of ownership of their condition tend to experience greater therapeutic benefit post-operatively.

Introduction

Patient satisfaction[1–3] and functional outcomes[4,5] after spine surgery are dictated by many non-surgical factors. These factors include depression, worker's compensation, socioeconomics and education level. The complex social combination of these factors is also influenced by patient expectations[6]. Despite our awareness of the influence these factors have on spine surgery, surgeons are not always accurate in predicting which of their own patients are dissatisfied after surgery[7].

A potentially interesting variable to explore as a tool is the use of a locus of control scale. Locus of control is a concept derived from social learning personality theory. Social learning theory is grounded in reinforcement values and social context as they relate to personality development[8]. The theory describes locus of control as personal beliefs about what controls an individual's life circumstances. The commonly described "loci" include the internal and external locus of control. For example, those with a high internal locus of control may deem their actions to be impactful on a desire outcome in their life. Comparatively, a person with an external locus of control may deem an outcome to be primarily due to luck or chance. These loci of control are believed to co-exist in different balances in every individual.

This theory has been expanded and has generated a variety of questionnaires to assess other loci like chance, others, and doctors[9,10]. An individual's locus of control have been proven to remain relatively stable over time, much like other personality traits[11]. More specifically, health locus of control has been developed as a tool to assess the degree to which patients attribute their conditions to their doctors among the other domains of internal (self/behaviors), others (actions of others/environment), and chance (luck/fate)[8]. For example, a person with a health locus of control highest in the doctor domain may deem their health to be in the hands of their physician rather than seeing their health as a product of their actions, which would be considered an internal locus of control. With a chance locus of control, patients feel as though their health is due to factors of luck. Health locus of control has been shown to influence satisfaction with medical care, preferences for decision-making and communication, and health behaviors like adherence[12–16]. Health locus of control has been previously studied in patients with chronic

lower back pain undergoing conservative management with rehabilitation[17]. This study found health locus of control to be a potentially valuable predictor for treatment benefit. We believe that patients' pre-existing locus of control may influence their perceived benefit from spinal surgery as demonstrated by NDI/ODI/VAS scores. The aim of this study is to investigate the relationship between health locus of control and post-operative outcomes in patients who underwent cervical or lumbar spine surgery.

Methods

Study design and population.

A retrospective, cross-sectional analysis included 119 patients treated at an academic institution with one of the following operations between 2019 and 2022: 1 level or more anterior or posterior cervical/lumbar fusions, 1 level or more cervical/lumbar laminectomy, and 1 level or more cervical corpectomy. The patient cohort was identified via CPT codes related to the operations listed above. Our exclusion criteria include the following:

- Pregnancy
- Revision surgery or previous surgery at the same level
- Traumatic spine injuries
- Surgery completed outside of the department of orthopedics
- Non-applicable surgery type (I.e., coccygectomy, kyphoplasty, micro/discectomy)

Data collection.

After successful identification, each patient was contacted by phone postoperatively. Participants who consented to being included in the study answered multiple questionnaires, including the Neck Disability Index (NDI) or Oswestry Disability Index (ODI) and the Multidimensional Health Locus of Control Scale-Forum C (MHLC-C), a validated survey to assess locus of control as it relates to disease[9,10]. Patients also rated their current level of pain using a scale from 0 to 10 (visual analog scale, VAS). Data on age, sex, body mass index (BMI), diabetes (DM), chronic obstructive pulmonary disease (COPD), and coronary artery disease (CAD) via chart review were collected. (IRB approval #: 2095826). NDI/ODI/VAS scores were used as the outcome variables in this work.

Instruments

The MHLC-C is a survey composed of 18 questions using a 6-point Likert scale aimed at assessing the locus of control in patients with chronic conditions[9,10]. The survey can be modified to include disease specific terms or may be left as a more general questionnaire about chronic conditions. This survey assesses four locus domains: *internal*, *chance*, *doctor*, and *others*[9,10]. Completed surveys produce numerical values for each of the four domains. The distribution of points in each domain varies with some survey takers scoring very high in one or two domains, while others have an even spread across all four domains. Domains with higher scores demonstrate the influence those domains have on a patient's perspective of their disease.

Analysis

Descriptive statistics were performed for both categorical and continuous variables. Descriptive categorical variables are reported as frequencies and percentages. Descriptive continuous variables are reported as median and interquartile range, as these variables were not normally distributed. Pearson correlation coefficients (r) were calculated between domains of locus of control to determine if these domains could be considered independent. Coefficients from 0.10 to 0.30 were identified as having a small correlation, 0.31 to 0.50 as having a medium correlation, and 0.51 and greater to be a large correlation[18].

A multivariate linear model was used to assess the overall statistical significance of domains of locus of control on NDI/ODI and VAS scores collected. The Pillai statistic was used to assess for overall significance, and post-hoc testing was conducted using standard linear models. Effect sizes were reported using partial eta squared (η^2_p); effects 0.01 to 0.05 were considered to have a small effect, 0.06 to 0.13 were considered medium, and values 0.14 and greater were considered to have a large effect[18].

Results

Descriptive characteristics

The demographic characteristics and comorbidities of our cohort can be seen in **Table 1**. The median time of follow-up since surgery to locus of control survey completion was 15 months (range 4 months to 3.4 years).

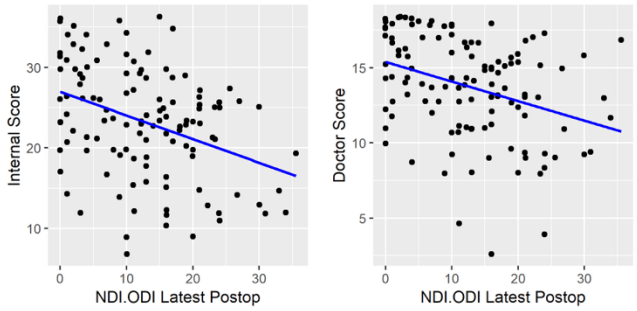
Table 1. Demographic characteristics.

Characteristics	
Sex	Male = 50 (42%) Female = 69 (58%)
Race	White = 114 (96%) Black = 4 (3%) Not listed = 1 (1%)
Age	62 year old IQR = [53, 68]
BMI	32.5 kg/m^2 IQR = [28.2, 36.8]
Diabetes	Prediabetic = 5 (4%) Yes = 27 (23%) No = 87 (73%)
COPD	Yes = 6 (5%) No = 113 (95%)
CAD	Yes = 23 (19%) No = 96 (81%)
ASA Class	Class 1 = 2 (2%) Class 2 = 41 (34%) Class 3 = 76 (64%)

Locus of Control and Post-operative NDI/ODI

Multivariable models for the locus of control domains and their influence on NDI/ODI scores demonstrated an overall statistically significant relationship with a large effect (l = 0.24, F(4, 117) = 8.8, p = 0.00, and η^2_p = 0.23). The *internal* locus had a significant effect on NDI/ODI scores (p = 0.00), with higher internal locus scores being associated with lower NDI/ODI scores. The influence of the *internal* locus on NDI/ODI was found to have a large effect size (F(1, 117) = 18.7, p = 0.00, η^2_p = 0.14). The *doctor* locus had a significant effect on NDI/ODI with a medium effect size (F(1, 117) = 15.6, p = 0.00, η^2_p = 0.12). A higher doctor locus of control was associated with lower NDI/ODI scores. The *chance* locus and *others* locus did not demonstrate a significant effect on NDI/ODI scores (p = 0.35 and 0.05, respectively). These results can be viewed in Figure 1.

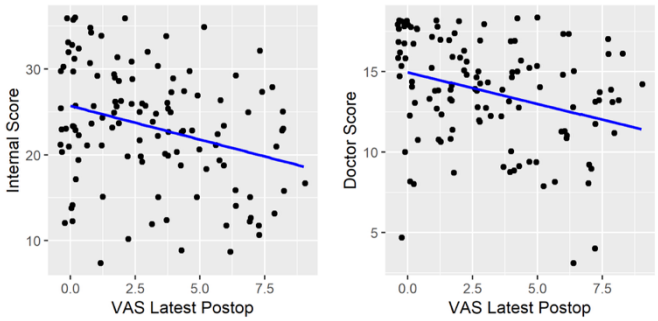
Figure 1. Locus of control and NDI/ODI scores



Locus of Control and Post-operative VAS

Multivariable models demonstrated overall significance with a large effect size (Pillai = 0.16, F (4, 117) = 5.59, p = 0.00, η^2_p = 0.16). Both *internal* and *doctor* loci had significant effects on VAS when assessed using post-hoc analyses. Higher *internal* and *doctor* locus scores were associated with lower VAS scores. The *internal* locus demonstrated a significant, medium effect on VAS (F(1, 117) = 11.1, p = 0.00, η^2_p = 0.086). The *doctor* locus demonstrated similar results with a medium effect (F(1, 117 = 12, p = 0.00, η^2_p = 0.094). The *chance* and *others* locus did not have a significant impact on VAS (p = 0.79 and 0.11, respectively). These results can be viewed in Figure 2.

Figure 2. Locus of control vs VAS



Discussion

In this study, the relationship between doctor locus of control and post-operative outcomes after spinal surgery was explored. The patients' doctor locus of control impacts their perception of therapeutic outcome after spinal surgery. The

potential to improve post-operative outcome measures by the internal and doctor loci was demonstrated.

Those who scored higher on the internal locus demonstrated significantly lower pain and disability index scores post-operatively. This finding suggests patients with a higher sense of ownership of their condition tend to experience greater therapeutic benefit post-operatively. While our current study did not assess changes in locus of control throughout the pre- and post-operative period, Keedy et al. investigated locus of control before and after implementation of a 2-week multidisciplinary rehabilitation program for chronic back pain and found that those with higher baseline internal locus of control and self-efficacy measures predicted higher physical function scores at the completion of the rehabilitation program[17]. Besides the evidence provided by Keedy, others have also focused on the health outcomes in spine patients and found similar results. Bazrafshan et al. found that patients with higher baseline internal locus of control had better general health scores, while Musich et al. found similar results that tracked back pain and found those with a higher internal locus of control value reported lower subjective pain.[19,20] With concepts like this in mind, physicians may be able to use this to their advantage. Using surveys to identify patients' locus of control can be extremely useful, as a patient with a higher internal locus of control may be offered treatments that allow more patient self-guidance, such as therapy or home exercises.[21] Our current findings, compared with Keedy, Bazrafshan, and Musich's prior work, help to highlight that recovery from diseases affecting the spine is multimodal and that therapeutic relief is greatly influenced by patients' pre-existing mindsets and perspectives.

In the current study, the doctor locus was inversely related to pain and disability index scores, which contradicts some of Keedy's previous findings. The study demonstrates that patients with higher doctor loci scores tend to have lower pain and disability scores post-operatively. In Keedy's original work, lower doctor locus was associated with improved physical function at the end of rehabilitation. While this may seem contradictory, these differences highlight the importance of choosing the right treatment for the right patient. People with lower doctor locus may have greater benefit from a multidisciplinary rehabilitation program compared to those with higher doctor locus which may benefit from procedural interventions, such as surgery or epidural steroid injection, as well as drug therapies designed by the physician earlier in their disease course.

There are three main limitations to our study. The first of which is the cross-sectional nature of the study design. While cross-sectional studies provide data that accurately reflects a short window of time, the results from the study are not longitudinal in nature, which decreases their overall generalizability. The second weakness is the potential for a carryover effect after the administration of multiple surveys. The carryover effect refers to the potential for prior questions or surveys to influence answers to other questions. The final weakness is a lack of racial diversity, which greatly limits generalizability.

Overall, the research demonstrates that for those whose domains are internal, doctor, or a mix of the two, may experience greater therapeutic effects after undergoing spinal surgery compared to those with the locus of *others* and *chance*. The effect of locus of control on spinal surgery patient-reported outcome measures highlights the complexity behind non-surgical patient characteristics and perceived therapeutic effect after surgery.

Conclusion

Using Locus of Control data for new and existing patients may bring substantial benefit to decision-making in clinic for patients with spinal-related concerns. With data showing that patients with domains of both internal and doctor seem to have better self-reported outcomes, this data can be transferred to clinic use. In new patients or existing, returning patients who have never completed the Locus of Control paperwork, these patients should be offered the form to complete. The data can then be reviewed before seeing the patient with the other members of the care team so that when seeing the patient, more knowledgeable options can be properly offered to the patient. For example, surgery may be offered earlier for patients coming in that have stronger internal or doctor domains, but beforehand will be offered treatment tactics that may fit their domains better, such as offering more shared decision making or suggestions based on clinical expertise, respectively. This level of care will be more personalized for each patient, which will likely give patients more comfort and a sense of fulfillment with their care that can lead to better outcomes overall.

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