Objective measurement of function following lumbar spinal stenosis decompression reveals improved functional capacity with stagnant real-life physical activity

Matthew Smuck, MD\textsuperscript{a,*}, Amir Muaremi, PhD\textsuperscript{a}, Patricia Zheng, MD\textsuperscript{a}, Justin Norden, MPhil\textsuperscript{b}, Aman Sinha, MPhil\textsuperscript{c}, Richard Hu, MD\textsuperscript{d}, Christy Tomkins-Lane, PhD\textsuperscript{e}

\textsuperscript{a}Department of Orthopaedic Surgery, Stanford University, 450 Broadway, Redwood City, CA 94063, USA
\textsuperscript{b}Stanford University School of Medicine, 291 Campus Dr, Li Ka Shing Building, Stanford, CA 94305, USA
\textsuperscript{c}Department of Electrical Engineering, Stanford University, 350 Serra Mall, Stanford, CA 94305, USA
\textsuperscript{d}Department of Surgery, University of Calgary, 1403 29 St NW, Calgary, AB T2N 2T9, Canada
\textsuperscript{e}Department of Health and Physical Education, Mount Royal University, 4825 Mount Royal Gate SW, Calgary, AB T3E 6K6, Canada

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Abstract

BACKGROUND CONTEXT: Lumbar spinal stenosis (LSS) is a prevalent and costly condition associated with significant dysfunction. Alleviation of pain and improvement of function are the primary goals of surgical intervention. Although prior studies have measured subjective improvements in function after surgery, few have examined objective markers of functional improvement.

PURPOSE: We aimed to objectively measure and quantify changes in physical capacity and physical performance following surgical decompression of LSS.

STUDY DESIGN/SETTING: Prospective cohort study.

PATIENT SAMPLE: Thirty-eight patients with LSS determined by the treating surgeon’s clinical and imaging evaluation, and who were scheduled for surgical treatment, were consecutively recruited at two academic medical facilities, with 28 providing valid data for analysis at baseline and 6 months after surgery.

OUTCOME MEASURES: Before surgery and at 6 months after surgery, participants provided 7 days of real-life physical activity (performance) using ActiGraph accelerometers; completed two objective functional capacity measures, the Short Physical Performance Battery and Self-Paced Walking Test; and completed three subjective functional outcome questionnaires, Oswestry Disability Index, Spinal Stenosis Symptom Questionnaire, and Short-Form 36.

METHODS: Physical activity, as measured by continuous activity monitoring, was analyzed as previously described according to the 2008 American Physical Activity Guidelines. Paired \( t \) tests were performed to assess for postsurgical changes in all questionnaire outcomes and all objective functional capacity measures. Chi-square analysis was used to categorically assess whether patients were more likely to meet these physical activity recommendations after surgery.

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RESULTS: Participants were 70.1 years old (±8.9) with 17 females (60.7%) and an average body mass index of 28.4 (±6.2). All subjective measures (Oswestry Disability Index, Spinal Stenosis Symptom Questionnaire, and Short-Form 36) improved significantly at 6 months after surgery, as did objective functional measures of capacity including balance, gait speed, and ambulation distance (Short Physical Performance Battery, Self-Paced Walking Test). However, objectively measured performance (real-life physical activity) did not change following surgery. Although fewer participants qualified as inactive (54% vs. 71%), and more (11% vs. 4%) met the physical activity guideline recommendations at the 6-month follow-up, these differences were not statistically significant (p=0.22).

CONCLUSIONS: This is the first study, of which we are aware, to objectively evaluate changes in postsurgical performance (real-life physical activity) in people with LSS. We found that at 6 months after surgery for LSS, participants demonstrated significant improvements in self-reported function and objectively measured physical capacity, but not physical performance as measured by continuous activity monitoring. This lack of improvement in performance, despite improvements in self-reported function and objective capacity, suggests a role for postoperative rehabilitation focused specifically on increasing performance after surgery in the LSS population.

Keywords: Capacity; Function; Lumbar spinal stenosis; Outcome; Performance; Physical activity; Surgery

Introduction

Lumbar spinal stenosis (LSS) is a debilitating [1–6] and costly condition [7–9] responsible for more than 7,000 quality-adjusted life-years of work loss [10]. It is also the most common reason for spine surgery in individuals older than age 65 [11]. Alleviation of pain and improvement in function are the primary goals of surgical intervention for LSS. Various groups have investigated both the short- and the long-term functional outcomes of LSS surgical management [1–6, 12–15]. However, these studies relied on a variety of different patient reported outcomes, which are subject to multiple potential inaccuracies [16, 17] and are not reflective of objective functional measurements [18].

When considering function, it is important to recognize the two distinct categories, defined by the International Classification of Functioning: capacity and performance [19]. Capacity represents the capability of a person to complete a given task in a controlled environment (eg, a timed walking test), whereas performance represents what a person does in his or her current environment (real-life physical activity). The few studies that have objectively assessed functional changes after treatment for LSS have most often tested capacity with timed walking test or similar measures [4, 15, 20]. Although many tools exist to capture capacity in research and in the clinical setting, the ability to measure performance remains limited in both settings. Continuous activity monitoring seems a logical means of assessing performance by measuring free-living physical activity; yet, to date, only a handful of spine studies have employed activity monitors [21].

Decreased performance is a serious problem in patients with LSS given that physical inactivity is a risk factor for many chronic diseases including diabetes, obesity, and heart disease [22]. Conversely, it is recognized that increased physical activity can improve both pain and function in this population [23, 24]. Accordingly, to achieve substantial health benefits, the 2008 American Physical Activity Guidelines calls for participation in 150 minutes of moderate to vigorous physical activity per week, accumulated in bouts of 10 minutes or more [25]. We previously found that only 4% of patients with neurogenic claudication meet these physical activity guidelines, with 75% not achieving even one qualifying bout of moderate to vigorous physical activity within 1 week [26].

Because surgical decompression of LSS is known to improve capacity [4, 15, 20], we hypothesize that it will also improve performance (real-life physical activity). The goal of this study is to objectively measure and quantify changes in physical capacity and performance following surgical decompression of LSS. The Editor-in-Chief of The Spine Journal recently called for spine outcomes research to adopt objective measures to overcome the inherent limitations of a science built almost exclusively on self-report [16]. To our knowledge, this is the first study to objectively measure the functional impact of spine surgery on patients with spinal stenosis in both categories of human function: capacity and performance.

Materials and methods

Study design

This is a prospective observational study of patients scheduled to undergo surgical treatment of LSS. Participants were consecutively recruited at two academic medical centers in North America including (Stanford University and the University of Calgary). Ethics approval for this study was provided from both institutions, and the study was conducted in a Health Insurance Portability and Accountability Act-compliant manner.

Inclusion and exclusion criteria

Patients were considered for enrollment if they were at least 40 years of age, had received a diagnosis of LSS, and were scheduled for surgical treatment of LSS through a shared...
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