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Technical Report

Lumbar Stiffness Disability Index: pilot testing of consistency, reliability, and validity

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Abstract

BACKGROUND CONTEXT: The primary goal of surgical arthrodesis is to eliminate the motion of spinal segments in an effort to alleviate pain, improve deformity, and reduce disability. However, decreased spinal mobility may impair performance of activities of daily living (ADLs) due to the resulting stiffness or the lack of mobility of the fused segment. Current clinical outcome instruments do not seek information regarding the impact of spinal stiffness on functional ability. Therefore, a patient-reported outcome questionnaire measuring the impact of lumbar stiffness on functional abilities was devised and assessed for internal consistency, retest repeatability, and external validity.

PURPOSE: To develop and validate an outcome instrument to measure the collateral effect of stiffness after lumbar fusion on functional ability.

STUDY DESIGN: Cross-sectional pilot study.

PATIENT SAMPLE: Consecutive cohort of lumbar spine fusion patients from a single surgeon's practice.

OUTCOME MEASURES: Lumbar Stiffness Disability Index (LSDI) and Cobb angle measurements from digital radiographs.

METHODS: We developed and evaluated a 10-item questionnaire, referred to as the LSDI, which seeks information on the impact of spinal stiffness on ADLs after lumbar spinal arthrodesis. The questionnaire yields a score from 0 to 100, with higher scores indicating greater difficulty resulting from lumbar spinal stiffness in performing 10 different ADLs. The study sample comprised 32 lumbar arthrodesis patients at a minimum of 1 year postoperatively.

All patients completed the questionnaire twice via telephone interviews conducted 4 weeks apart. Internal consistency was assessed using the Cronbach alpha, and retest reliability was measured using an intraclass correlation coefficient (ICC). External validity of the questionnaire was evaluated by correlating the scores with lumbar range of motion (LROM) as measured from the angular change between the inferior end plate of T12 and the superior end plate of S1 on standardized digital flexion and extension lateral radiographs.

RESULTS: The study sample included 22 women (69%) and 10 men (31%) with an average age of 63 years. The questionnaire demonstrated high internal consistency (Cronbach alpha=0.89).

FDA drug/device status: Not applicable.

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Retest reliability was also high (ICC=0.87). External validity was demonstrated by a statistically significant inverse relationship between LROM and LSDI scores ($r=-0.71$; $p<.001$).
CONCLUSIONS: This pilot study demonstrates that the LSDI questionnaire is a reliable and valid instrument for assessing functional limitations due to lumbar stiffness among spinal arthrodesis patients. The questionnaire is proposed for use in prospective evaluation of lumbar stiffness impacts after arthrodesis.

Keywords: Spinal fusion; Scoliosis; Degenerative disease; Lumbar spine; Adverse events

Introduction

Spinal arthrodesis surgery is increasingly performed in the United States for the treatment of trauma, degenerative disease, tumor, infection, and deformity of the spine [1,2]. Although spinal arthrodesis procedures often alleviate pain and dysfunction associated with spinal pathology, the ultimate goal of the fusion is to eliminate motion of the affected spinal segments. As spinal mobility is integral to performing activities of daily living (ADLs), stiffness from fusion may negatively impact specific functional abilities even if the surgery results in decreased pain and improved overall functional status [3].

Outcome instruments specifically developed to evaluate the impact of spinal conditions, such as the Oswestry Disability Index (ODI) and the Scoliosis Research Society-22, assess the ability of these procedures to reduce pain, reduce deformity, and increase patients' overall level of function [4–7]. Although these outcome instruments provide information on functional limitations due to back and leg pain, they do not seek information regarding deficits in performing ADLs because of lumbar spine stiffness. Quality of life questionnaires such as the Short Form-36 are also frequently used in clinical studies of lumbar spine patients [8–10], but similarly do not assess functional limitations due to stiffness.

An instrument designed to assess limitations in ADLs due to stiffness after lumbar spine arthrodesis would potentially help answer patients' questions regarding expected impacts of spinal fusion resulting from reductions in spinal mobility. We have developed an outcome questionnaire, referred to as the Lumbar Stiffness Disability Index (LSDI), for this purpose. This article describes the content and structure of the LSDI and an assessment of its internal consistency, test-retest reliability, and external validity.

Materials and methods

Development and structure of the LSDI

The functional domain of the questionnaire is based on reports from our own lumbar fusion patients [11]. Ten questions request information regarding the impact of low back stiffness on ADLs, such as dressing, hygiene, mobility, and sexual activity (Table 1). Responses are scored from 0 (''No effect at all'') to 4 (''I cannot do this at all''). The raw score on the questionnaire, therefore, ranges from 0 to 40. The overall score is computed as the raw score divided by the total possible score and multiplied by 100. LSDI scores thus range from 0 to 100, with higher scores indicating greater disability. If a patient declines to answer a question, the final score is scaled for the number of questions answered.

Patient sample

The LSDI was administered to 32 English-speaking adult patients at a minimum of 1 year after lumbar arthrodesis of one to five or more lumbar motion segments. All patients were verified to have achieved a solid fusion based on the flexion-extension lateral radiographs. Surgical indications included spondylolisthesis, spinal deformity, adjacent segment stenosis, and degenerative disc disease. Patients undergoing arthrodesis for cancer, infection, or trauma were excluded.

Each patient completed the LSDI on two occasions. Patient contact for the retest began at 4 weeks after the first administration. Thus, LSDI readministration took place at least 4 weeks after the first administration. Institutional review board–approval was obtained for this study.

Statistical methods

Internal consistency

We first examined distributions of responses to each item separately to evaluate proportions with missing data and possible skew. The distribution of the total score was summarized with a mean and standard deviation. We computed the Cronbach alpha statistic, which measures the degree of internal consistency of response items represented by a scale or score. Cronbach alpha values ranged from 0 to 1, with higher values indicating greater correlation among the questionnaire items. High internal consistency indicates that patients with higher scores on one question also tend to score higher on other questions, that is, the questions assess related functional domains. For clinical studies, a Cronbach alpha value of 0.9 or greater is ideal, whereas 0.7 or greater is considered satisfactory [12].

Retest reliability

To assess retest repeatability, we computed an intraclass correlation coefficient (ICC), a measure of the reproducibility of repeated measures of the same patient [13]. Values of the ICC range from 0 to 1; values of 0.75 or greater indicate