ORIGINAL ARTICLE

Changes in Objectively Measured Physical Activity (Performance) After Epidural Steroid Injection for Lumbar Spinal Stenosis

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ABSTRACT. Tomkins-Lane CC, Conway J, Hepler C, Haig AJ. Changes in objectively measured physical activity (performance) after epidural steroid injection for lumbar spinal stenosis. Arch Phys Med Rehabil 2012;93:2008-14.

Objective: To examine changes in objectively measured physical activity (performance) at 1 week following epidural steroid injection for lumbar spinal stenosis.

Design: Prospective cohort.

Setting: University spine program.

Participants: Individuals (N=17) who were undergoing fluoroscopically guided epidural steroid injection for symptomatic lumbar spinal stenosis (mean age ± SD, 70.1±6.7; 47% women).

Intervention: Fluoroscopically guided epidural injection.

Main Outcome Measure(s): The 2 primary outcomes, measured with accelerometers, were total activity (performance) measured over 7 days and maximum continuous activity (capacity). Walking capacity was also assessed with the Self-Paced Walking Test, and subjects completed the Oswestry Disability Index, Swiss Spinal Stenosis Questionnaire, Medical Outcomes Study 36-Item Short-Form Health Survey, visual analog pain scales, and body diagrams.

Results: At 1 week postinjection, 58.8% of the subjects demonstrated increased total activity and 53% had increased maximum continuous activity, although neither change was statistically significant. Significant improvements were observed in a number of the self-report instruments, including the Physical Function Scale of the Swiss Spinal Stenosis Questionnaire, general health (Medical Outcomes Study 36-Item Short-Form Health Survey), role-limitation emotional (Medical Outcomes Study 36-Item Short-Form Health Survey), leg pain intensity (visual analog pain scales), and presence of leg weakness.

Conclusions: While patients perceived improvements in pain and function following injection, these improvements were not reflected in significant changes in performance or capacity. Future studies will continue to find value in subjective measures of pain and quality of life. However, with modern technology, performance is no longer a subjective variable. Use of activity monitors to objectively measure performance can result in more rigorous validation of treatment effects, while simultaneously highlighting the potential need for additional postinjection rehabilitation aimed at improving performance.

Key Words: Body mass index; Injections, epidural; Lumbar spinal stenosis; Physical activity; Rehabilitation; Spinal stenosis; Walking.

PRIMARY GOALS when treating symptomatic lumbar spinal stenosis (LSS) include symptom reduction and restoration of walking function. Epidural steroid injections (ESIs) are commonly used for these purposes in people with LSS.[1] It is thought that ESIs may help reduce pain and improve standing and walking tolerance.[2]

Treatment of LSS using various ESI techniques (transforaminal, caudal, interlaminar, fluoroscopically guided, and non–fluoroscopically guided) has been described.[3-6] Yet there have been a limited number of studies evaluating the efficacy of ESI for LSS. Studies evaluating non–fluoroscopically guided ESI for LSS all showed short-term benefit ranging from 1 week to 2 months of relief.[4,6,7] More recent studies that used fluoroscopic guidance demonstrate variable results, with all showing some short-term benefit (1wk–2mo).[3,8-13] Although most studies of ESI for LSS have demonstrated consistent short-term improvement in subjective symptoms and perceived function,[3,5,6,14,15] it has been suggested that more rigorous measurement of function is warranted.[16]

Recent research with the LSS population suggests that when measuring physical function, we need to recognize and assess the 2 distinct components: capacity and performance.[17] Defined by the International Classification of Functioning, Disability and Health capacity is the ability to perform a given task in a controlled environment, while performance reflects physical activity in the context of a person's real life.[18] It appears that the majority of traditional outcomes used with LSS populations (questionnaires, walking tests) are assessing the construct of capacity, not performance.[17] It is thought that the goal of intervention is to improve performance—actual physical activity and function in daily life. Therefore, performance is a

List of Abbreviations

BMI	body mass index
ESI	epidural steroid injection
LSS	lumbar spinal stenosis
MCID	minimal clinically important difference
ODI	Oswestry Disability Index
SF-36	Medical Outcomes Study 36-Item Short-Form Health Survey
SPWT	Self-Paced Walking Test

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critical outcome for the LSS population.[19] Performance is important in identifying barriers to function and the impact of spinal pathology on real life.

Only recently, using activity monitors (accelerometers) have we been able to objectively measure performance. To our knowledge, the effect of ESI on performance has yet to be examined in an LSS population. Therefore, the objective of this study was to examine changes in objectively measured physical activity (performance) in people undergoing ESI for symptomatic LSS.

METHODS

Subjects

Possible participants were identified through review of the clinic schedule for the University of Michigan Spine Program. Participants were identified if they were scheduled for fluoroscopically guided ESI for symptomatic LSS by physicians certified in both physical medicine and rehabilitation, and pain medicine. To be included, participants were required to have documented LSS diagnosed by a physiatrist or a surgeon who had examined both the patient and the lumbar magnetic resonance imaging. A clinical presentation of LSS (reported neurogenic claudication) was also required for inclusion. After being identified, subjects were contacted by phone. This method was chosen given the rapid time frame between scheduling and actual injection. Potential participants were asked whether they were interested in hearing about the study. If interested, they were provided with information. Subjects agreeing to participate were scheduled for a meeting with research staff the week prior to their injection to review inclusion and exclusion criteria, as well as the informed consent documents. Exclusion criteria included disk herniation or any disorder other than spinal stenosis that in the opinion of the investigators could put the subject at risk during testing or act as the rate-limiting factor in ambulation (balance disorders, chronic obstructive pulmonary disorder, asthma, neuromuscular disease, severe lower limb arthritis, polyneuropathy, peripheral vascular disease). This project was granted approval by the Institutional Review Board at the University of Michigan.

Data Collection and Measures

One week prior to injection, participants completed a questionnaire and the Self-Paced Walking Test (SPWT). Subjects were provided with an activity monitor (Actigraph[a] GT1M) and instructed to wear it for the 7 days prior to their injection.

Self-report measures. The baseline questionnaire included demographic information, 10-cm visual analog pain scales for the back and legs, and a body diagram for indicating the location of pain, numbness, tingling, and weakness. A minimal clinically important difference (MCID) of 1.6cm for leg pain and 1.2cm for back pain has been suggested by Copay et al[20] on the basis of the evaluation of lumbar spine patients (28.5% had LSS), while Parker et al[21] suggest an MCID of 5.0cm for leg pain and 2.2cm for back pain on the basis of a study of patients with LSS. Standardized instruments included in the questionnaire were the Oswestry Disability Index (ODI), the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36), and the Symptom Severity and Physical Function Scales of the Swiss Spinal Stenosis Questionnaire.

The ODI is a 9-item questionnaire designed to provide information regarding how back and/or leg pain affects a person's ability to function in daily life.[22] Severity of pain and disability in activities such as walking, standing, personal care, and travel are rated on a 5- or a 6-point scale. This instrument is psychometrically sound and is recommended as a standard measurement to assess back pain–related function.[23-26] It has been validated specifically for the LSS population.[27] Published values for MCID on the ODI in LSS populations include 8.2,[21] 11,[28] and 12.8.[20]

The 5-item Physical Function Scale of the Swiss Spinal Stenosis Questionnaire is primarily used to assess walking capacity. Limitations are rated on a 1 to 4 scale, with a lower score indicating better physical function. The 7-item Symptom Severity Scale was included to examine the severity of symptoms related to LSS. Both the Physical Function Scale and the Symptom Severity Scale have previously been demonstrated to be internally consistent, reliable, and responsive to clinical change in the LSS population.[27,29-32] The published MCID for both scales is 0.5.[30]

The SF-36 is a multidimensional generic health status instrument that consists of 8 health concept scales (physical functioning, role limitation-physical, bodily pain, general health, vitality, social function, role limitation-emotional, and mental health). Each scale score is calculated independently. For each scale, item scores are summed and transformed into a scale ranging from 0 (indicating worse health state) to 100 (indicating best health state). In total, the instrument contains 36 items that represent a broad array of health concepts.[33] The psychometric properties of the SF-36 have been well established.[34] An MCID of 3 for the SF-36 subscales has been suggested for back pain populations by Lauridsen et al.[28] Although not specific to LSS, Samsa et al[35] similarly suggest a range of 3 to 5 as a minimal clinically important change for all scales in the general population.

Walking test and clinical measures. After completing the questionnaire, subjects completed an SPWT.[36] In the SPWT, walking capacity is measured as the distance a person is able to walk on a flat surface at a self-selected pace until being forced to stop because of symptoms of LSS (or other reasons). The SPWT was developed for use as a criterion measure of walking capacity in patients with LSS and has been shown to have high retest reliability in this population.[36] Subjects completed the SPWT along a flat hallway indoors or along the even surface of an outdoor parking lot. Subjects walked continuously until they felt that they needed to stop or until the maximum time of 30 minutes was reached. Time was kept by stopwatch, and distance was measured via a distance wheel directly following the path of the subject.

Activity monitors. Upon completion of the walking tests, subjects were provided with an activity monitor (Actigraph GT1M) to wear for 7 days. Subjects were instructed to wear the activity monitors from the time they woke up in the morning to the time they went to bed at night for the 7 days prior to their epidural injection. Activity monitors were worn on an elastic band around the waist at the level of the hip on the same side (left or right) for all testing days. Subjects were instructed to remove the monitor only when in contact with water (bathing, swimming). The monitors were collected by staff at the time of the subject's epidural injection.

Activity monitors (accelerometers) are small devices usually worn on the hip or lower back[37] that measure movement in terms of acceleration.[38] Acceleration is recorded as a voltage signal, and these voltage outputs are known as "counts." Counts can be used to estimate volume, duration, and intensity of physical activity. A large body of literature supports the validity and reliability of accelerometers for the measurement of physical activity in older adults.[39-43] There is a general consensus that accelerometers provide a valid indicator of overall physical activity.[44]

Follow-up. One week following injection, all participants were asked to return to repeat testing, including the question-