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Effects of a Home Exercise Program on the Self-report Disability Index and Gait Parameters in Patients with Lumbar Spinal Stenosis

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Abstract. [Purpose] The present study was performed to identify the effect of a home exercise program on the self-reported disability index and gait parameters in patients with lumbar spinal stenosis (LSS). [Methods] Fifteen patients with LSS were enrolled in this study and were trained in a 4-week home exercise program (40 min/day). All patients were evaluated with three self-reported disability indices (Oswestry Disability Index, Roland-Morris Disability Questionnaire, and Spinal Stenosis Scale), and gait parameters were assessed using a GAITRite system before and after the home exercise program. [Results] Patients with LSS showed significant decreases in the self-reported questionnaire scores and pain intensity after the home exercise program. However, the gait parameters did not significantly change. [Conclusion] These findings suggest that home exercise programs can improve self-reported questionnaire scores and decrease pain in patients with LSS.

Key words: Lumbar spinal stenosis, Home exercise, Self-reported questionnaires

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INTRODUCTION

Approximately 20% of people older than 65 years suffer from low back problems[1)]. In particular, lumbar spinal stenosis (LSS) is a prevalent and disabling condition in the elderly population. The main symptoms are described as back and buttock pain and/or weakness, numbness, and neurologic claudication that is exacerbated by standing, backward bending, and walking[2)].

To manage patients with LSS, decompressive laminectomy and fusion procedures are commonly recommended[3)]. Katz et al.[4)] reported that surgical operations improve patients' functional ability and that 60% to 80% of patients are satisfied. However, 4 years after spinal stenosis surgery, referred pain may develop, and severe impairment decreases the physical aspects of patients' quality of life[5)]. The most negative element of repeat surgery is its high cost[6)]; the reoperation rate for patients with LSS is 5% to 23%[7)]. Notably, 21 studies of predictors of postoperative clinical outcomes in LSS identified depression, cardiovascular comorbidities, walking inability, and poor subjective outcomes[8)].

Conservative treatment such as therapeutic exercises may achieve clinical recovery, improvements in disability, reductions in pain, increased satisfaction, and better function among patients with chronic low back pain and LSS[9)], and many studies[10)] have investigated the effectiveness of conservative interventions (lumbar flexion exercises, stretching, and mobility exercises). However, the pain often recurs when the exercise program is discontinued. The recent increase in the aging population and rising incidence of chronic disease have led to higher medical expenses[11)], and policy makers are moving in the direction of self-management of chronic conditions[12)]. Therefore, to effectively manage patients with LSS, a home exercise program may be needed.

It has been reported that patients with LSS have an altered gait pattern due to symptom such as neurologic claudication[13)]. Wide-based gait, slow walking, and short stride are often shown to alleviate neurologic claudication in patients with LSS[13, 14)]. Although self-stretching of the hip flexors as a home exercise is recommended for pain-free gait in patients with LSS[15)], there is limited experimental evidence.

Backstrom et al.[15)] argued that exercise is essential in the treatment of patients with LSS and suggested a specific self-exercise program. However, few studies have compared the effects of home exercise among community-dwelling patients with LSS. The purpose of this study was to identify the effect of a 4-week home exercise program in terms of how it affects self-reported questionnaire scores and gait parameters in community-dwelling patients with LSS.

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SUBJECTS AND METHODS

All participants (nine females and six females, 68.2 ± 5.8 years of age, 61.93 ± 9.5 kg, 161.2 ± 8.3 cm) were diagnosed with degenerated LSS by physicians using magnetic resonance imaging or computed tomography. All participated in a health-promotion program in a community health center in Pusan, South Korea. The inclusion criteria were 1) age of 55 years or more; 2) pain in the low back, buttocks, gluteal region, or/and lower extremity; and 3) alleviation of symptoms of neurogenic claudication when sitting or lying and aggravation of symptoms when standing and walking. Subjects were excluded if they had severe neurologic signs and symptoms, coronary artery disease, severe vascular or pulmonary disease, recent lumbar–thoracic fractures, spinal tumor or infection, or lower extremity fracture. All participants provided informed consent before participation. Ethical approval was obtained from the INJE University Ethics Committee for Human Investigations. All subjects were evaluated using three self-reported low back disability scales (Oswestry Disability Index [ODI], Roland-Morris Disability Questionnaire [RDQ], and Spinal Stenosis Scale [SSS]) to assess their level of pain and functional status before and after the home exercise program. To assess the walking velocity and stride and step lengths, we used a GAITRite system (CIR Systems, Inc., Sparta, NJ, USA), which detects the activation of sensors and automatically calculates the spatiotemporal gait parameters. During the 4-week exercise program, all participants were asked to perform exercises 5 days/week (total of 20 repetitions), and each session was –40 min in duration. The home exercise program comprised knee-to-chest exercises, thoracic extension self-mobilization, double knee-to-chest exercises, lower abdominal strengthening exercises, lumbar rotation stretching, hip abduction strengthening exercises, rectus femoris self-stretching, and iliopsoas self-stretching, as reported by Backstrom et al.[15]. The results were analyzed statistically using the paired t-test, and statistical significance was set at a value of $p \leq 0.05$. All analyses were performed using the SPSS ver. 17.0 software package.

RESULTS

The ODI ($r = 0.702$, $p < 0.004$), RDQ ($r = 0.939$, $p < 0.000$), SSS-SS ($r = 0.885$, $p < 0.000$), and SSS-FS ($r = 0.765$, $p < 0.001$) scores were improved significantly after home exercise. Among the spatiotemporal gait parameters, walking velocity ($p = 0.09$), step and stride lengths on the left ($p = 0.51$ and $p = 0.99$, respectively), and step and stride lengths on the right ($p = 0.86$ and $p = 0.61$, respectively) were not changed significantly. Before and after the exercise program, the walking pain intensity was improved significantly ($p = 0.05$ and $p = 0.026$, respectively) (Table 1).

DISCUSSION

We assessed the effect of home exercise on self-reported questionnaire scores and gait parameters in patients with LSS. Our data demonstrate the positive effects of home exercise. Lumbar flexion exercises are effective for increasing the sagittal plane dimensions of the central spinal canal, strengthening the abdominal muscles, and improving spinal mobility[15, 16]. Furthermore, improved hip flexibility is frequently necessary for a pain-free gait in patients with LSS[15]. A previous case study[17] and one randomized controlled trial[9] reported that lumbar flexion exercises reduced pain and significantly improved the average ODI score among patients with LSS. In addition, combined flexion exercise (treadmill walking with body weight support vs. cycling) was beneficial, as evidenced by both the modified ODI and RDQ scores[18]. However, our study showed no changes in the gait parameters. Gait training was not performed in our study. In some studies, unlike ours, lumbar flexion exercises and gait training were performed together. Whitman et al.[9] suggested two 6-week conservative treatment programs for patients with LSS; one program included manual therapy, body weight-supported treadmill walking, and exercise, and the other program included lumbar flexion exercises, a treadmill walking program, and ultrasound therapy. Gait training in patients with LSS is beneficial to the cardiovascular system, enhances mobility and strength, and decreases fear avoidance issues related to walking[15]. These results suggest that home-based exercise with gait training is necessary to change gait parameters. We consider that specific gait training such as body weight-supported treadmill walking was not included in our home-exercise program, which resulted in no significant changes in gait parameters after the 4-week exercise program.

This study had several limitations: 1) the small number of subjects, 2) lack of a control group, and 3) complete exclusion of medications. However, our results regarding home exercise are encouraging and suggest that elderly patients with LSS can experience clinical improvement characterized by a marked reduction in symptoms and an

Table 1. Self-reported questionnaires and comparison of spatiotemporal gait parameters and pain intensity before home exercise and after home exercise

Variable	Mean ± SD	
	Before home exercise	After home exercise
ODI (%)	37.48±8.13	23.99±11.33*
RDQ	10.87±4.35	7.20±4.63*
SSS-SS	2.50±1.01	1.91±0.81*
SSS-FS	1.73±0.70	1.27±0.42*
Before VAS (100 mm)	32.66±30.58	23.66±24.81*
After VAS (100 mm)	52.00±26.77	43.00±25.26*
Lt step length (cm)	51.16±5.83	50.72±6.75
Lt stride length (cm)	101.78±12.51	101.80±15.21
Rt step length (cm)	50.11±6.94	49.97±7.92
Rt stride length (cm)	101.36±12.69	102.09±14.94
Velocity (cm/s)	85.82±16.97	89.18±16.99

ODI, Oswestry Disability Index; RDQ, Roland-Morris Disability Questionnaire; SSS-SS, Spinal Stenosis Scale-Symptom Subscale; SSS-FS, Spinal Stenosis Scale-Function Subscale; VAS, Visual Analogue Scale
*Significant difference from before home exercise ($p \leq 0.05$)

increase in function.

In conclusion, home exercise improved the scores of three self-reported questionnaires (ODI, SSQ, and RDQ), but it did not change gait parameters in patients with LSS in the current study. In future studies, the effects of home exercise that includes other lumbar spine exercises and gait training should be evaluated.

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