Factors associated with Low Back Pain in Patients with Lumbar Spinal Stenosis: A Cross-Sectional Study

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INTRODUCTION:
It is important to assess low back pain (LBP) in patients with lumbar spinal stenosis (LSS). Recent studies have investigated the mechanism of LBP and found that the following factors contribute to LBP: overweight, osteoporosis, spondylolisthesis, range of motion, spinopelvic alignment, muscle degeneration, intervertebral disc degeneration, Modic changes, and facet joint degeneration. Based on these findings, this study aimed to analyze the factors associated with LBP in patients with LSS.
METHODS:
This cross-sectional study included consecutive patients with LSS aged between 51 and 79 years who had symptoms in one or both the legs, with and without LBP. The participants were classified into two groups: the high group (LBP visual analogue scale [VAS] score ≥ 30 mm) and the low group (LBP VAS score < 30 mm). We compared the body mass index, lower extremity symptoms, VAS scores of lower extremity pain and numbness, bone mineral density, spondylolisthesis, range of motion, spinopelvic alignment, cross-sectional area and fat infiltration of the multifidus muscle, intervertebral disc degeneration, Modic changes, and facet joint degeneration between the high and low groups using the Mann–Whitney U test and the chi-square test. The high and low groups were defined as the dependent variables (high=1, low=0), and the crude odds ratios (OR) were calculated by using univariate logistic regression analysis without adjustment. Multivariate logistic regression was used to calculate adjusted OR with 95% confidence interval (CI) after controlling simultaneously for potential confounders ($p < 0.10$ in the univariate logistic regression analysis). Age, body mass index, VAS scores of lower extremity pain and numbness, bone mineral density, range of motion, thoracic kyphosis, LL, SVA, sacral slope, pelvic tilt, PI, PI-LL, cross sectional area, fat infiltration, and T2 value were included in the independent variables as continuous scale, and ORs were calculated for each 1-unit increase. Sex, lower extremity symptoms, spondylolisthesis, Modic change, and facet degeneration were included as independent variables as nominal scale, and ORs were calculated. We also performed a receiver operating characteristic (ROC) analysis of the significant variables to determine the boundary values of the VAS score for LBP. Statistical significance was set at $p < 0.05$.
RESULTS:
We found that 80 patients (mean age 64.5 ± 1.8 years; range, 51–79 years) satisfied the inclusion criteria. The high group included 47 patients (67.1%; 21 males and 26 females), and the low group included 33 patients (32.9%; 11 males and 12 females). The mean ages, body mass indices, and the fraction of lower extremity symptoms betweenof the high and low groups were not statistically significant. The high group had significantly higher mean VAS scores for LBP, and lower extremity pain and numbness than in the low group ($p < 0.01$). Moreover, there were no significant between-group differences in bone mineral density, frequency of occurrence of spondylolisthesis, and range of motion. The spinopelvic parameters showed statistically significant differences with regard to LL, SVA, and PI-LL between the two groups (LL, $p < 0.01$; SVA, $p < 0.01$; PI-LL, $p < 0.01$). Also, there was a significant between-group difference in the T2 value of the posterior annulus fibrosus at the L4–L5 level ($p < 0.01$), regarding the T2 values of the discs. There were no significant between-group differences in cross-sectional area and fat infiltration, frequency of occurrence of Modic changes, and facet joint degeneration. SVA was significantly associated with LBP (+ 10 mm; OR, 1.318; 95% confidence interval, 1.041–1.650), and this association remained significant after adjusting for other significant variables (+ 10 mm; OR, 1.331; 95% CI, 1.051–1.660). PI-LL was significantly associated with LBP (+ 1°; OR, 1.064; 95% CI, 1.017–1.167), and this association remained significant after adjusting for other significant variables (+ 1°; OR, 1.065; 95% CI, 1.019–1.168). The cut-off value, sensitivity, specificity, and area under the curve (AUC) for SVA were 47 mm, 55.3%, 83.3%, and 0.675, respectively. The cut-off value, sensitivity, specificity, and AUC for PI-LL were 30.5°, 31.9%, 96.7%, and 0.629, respectively.
DISCUSSION AND CONCLUSION:
This study found that SVA and PI-LL were significantly independently associated with LBP. SVA and PI-LL are important radiographic parameters found to be associated with LBP in spinal deformities. The present study cross-sectionally showed an association between LBP and SVA as well as between LBP and PI-LL, in SLSS, and indicated cut-off points of 47.0 mm for SVA and 30.5° for PI-LL. There have been reports of improved LBP and spinopelvic alignment after decompression surgery for LSS. The limitation of this study is that it is a cross-sectional study with a small sample size. Further work is needed to confirm, longitudinally, that SVA and PI-LL are associated with LBP in LSS. However, the cut-off values of 47.0 mm for SVA and 30.5° for PI-LL determined through ROC analysis would be positive predictive values for LBP in LSS. In conclusions, we compared lower extremity symptoms, bone mineral density, spondylolisthesis, range of motion, spinopelvic alignment, cross-sectional area and fat infiltration of the multifidus muscle, intervertebral disc

degeneration, Modic changes, and facet joint degeneration between patients with high and low LBP who had LSS. The mean SVA was 56.1 mm and 29.8 mm ($p < 0.01$) and the mean PI-LL was 15.7° and 9.4° ($p < 0.01$) in the high and low groups, respectively. Multivariate logistic regression analysis revealed that (SVA; + 1cm; OR, 1.331; 95% CI, 1.051–1.660) and pelvic incidence-lumbar lordosis (PI-LL; + 1°; OR, 1.065; 95% CI, 1.019–1.168) were significantly associated with LBP. ROC analysis revealed cut-off values of 47.0 mm of SVA and 30.5° of PI-LL, respectively. Our results indicated that SVA and PI-LL were significant predictors for LBP in LSS. It is suggested that these parameters should be taken into consideration when assessing LBP in patients with SLSS. Further work is needed to confirm our findings and to see if we can use these factors to guide interventions.