The Radiographic Signs In Plain Radiography Are Predictive Of Lumbar Spinal Canal Stenosis

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Background: Diagnosis of lumbar spinal canal stenosis (LSCS) generally requires both clinical evaluation and image interpretations. Although, magnetic resonance imaging (MRI) has been popularly known as the gold standard image, it is a fact that the plain radiography could provide the prompt and essential information for clinicians.

Objective: The purpose of this study was to identify and validate the plain radiographic signs for the prediction of LSCS by statistical analysis and machine learning.

Methods: Two hundred and one (201) patients who received both lumbar spine radiographs and MRI were included in this study. All the potential quantitative and qualitative parameters of the radiographs were obtained. Cross-sectional area of ligamentum flavum and dural sac were also measured by MRI. The correlation between the radiographic parameters and the diagnosis of LSCS were also established by the statistical analysis. Further, machine learning frameworks were applied to investigate the potential of these radiographic parameters for the prediction of LSCS. The diagnosis classification (LSCS or non-LSCS) model was developed by using feature selection (SFS, SBS, NCA), multiple machine learning algorithms (decision tree, SVM, KNN, and ensemble learning), and leave-one-out cross-validation.

Results: Among the 201 patients (mean age, 57 years 15; 111 men), 104 patients were diagnosed with LSCS, and 97 patients did not (mean age, 66 years 10 and 48 years 15) have LSCS. For the correlation between the radiographic and MRI parameters of LSCS, it was stated that vacuum disc, decreased lumbar motion, and the static spondylolisthesis were significantly important. Subsequently, the static spondylolisthesis ($p<.001$; OR: 6.39), decreased lumbar motion ($p=0.005$; OR: 0.95), degenerative scoliosis ($p=0.040$; OR: 2.74), and facet arthropathy ($p=0.032$; OR: 2.37), were correlated with the diagnosis of LSCS. Ultimately, the machine learning classification model selected the predictable features, which were strikingly compatible with the results of the statistical analysis.

Conclusion: The specific radiographic signs, including the static spondylolisthesis, decreased lumbar motion, degenerative scoliosis, and facet arthropathy, were both studied and correlated for the prediction of LSCS.