Comparison of MRI-Detected Spinal Pathologies and SPECT Positivity in Chronic Low Back Pain

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INTRODUCTION:

Chronic low back pain (CLBP) is a common clinical problem that is often the result of degenerative spinal changes. While magnetic resonance imaging (MRI) is the gold standard for evaluating spinal pathology, it may not reliably identify pain generators. Single-photon emission computed tomography (SPECT-CT) offers increased sensitivity and specificity in detecting bony activity and potential inflammation, which may help localize pain sources more accurately. However, its added diagnostic value over MRI remains uncertain. The purpose of this study was to evaluate and compare the efficacy of MRI and SPECT/CT imaging in the diagnosis of chronic lower back pain.

METHODS:

Patients aged ≥18 years who underwent MRI and SPECT-CT between August 2019 and December 2024, reported back pain for greater than 3 months, and failed physical therapy were included. Radiographic evaluation was performed by a board-certified orthopedic spine surgeon and board-certified musculoskeletal radiologist. MRI findings included the Modic changes, vacuum disc, vacuum facet, and Pfirrmann Grades (categorized as Grades 1-3 vs 4-5). SPECT positivity was assessed as EP (endplate findings) or Facet (facet findings). Level-specific Spearman correlation analyses were performed to assess relationship between MRI and SPECT findings. Multivariate logistic regression analyzed were conducted to identify MRI parameters predictors of SPECT positivity.

RESULTS:

A total of 122 patients were included. Within this cohort, 610 vertebral levels were analyzed for MRI Modic/Vacuum Disc/Vacuum Facet findings and 330 levels for MRI Pfirrmann Grading. The Spearman's rank-order correlation analyses (**Table 1**) revealed that SPECT EP findings were associated with Modic changes, vacuum disc, and advanced disc degeneration (Pfirrmann Grades 4-5) across multiple spinal levels. The strongest correlations between SPECT EP and Modic changes were observed at the L1-L2 ($r = 0.559$) and L5-S1 ($r = 0.496$) levels, with vacuum disc findings at L1-L2 ($r = 0.567$) and L3-L4 ($r = 0.598$), and with Pfirrmann at L4-L5 ($r = 0.658$) and L5-S1 ($r = 0.541$). SPECT facet findings showed weaker correlations with vacuum facet findings, with the strongest association at L5-S1 ($r = 0.451$). Multivariate logistic regression analysis identified several key predictors of SPECT findings (**Table 2**). Modic changes and advanced disc degeneration (Pfirrmann Grades 4-5) increased the likelihood of SPECT-EP ($R^2 = 0.515$). Finally, vacuum facet presence was the sole predictor of SPECT Facet ($R^2 = 0.195$), though the model explained less variability than for endplate findings.

DISCUSSION AND CONCLUSION:

These results demonstrate that CT and MRI findings in the lumbar spine are significantly correlated with and predictive of positive SPECT features associated with degenerative changes. The moderate strength of correlations and the fact that many of the associated features are already well-visualized on MRI or CT suggest that SPECT may not provide substantial additional diagnostic value. However, the R^2 values suggest that MRI and CT findings may provide stronger explanatory power in endplate findings compared to facet findings. Further research may be needed to identify specific situations where SPECT could offer unique and clinically relevant information that cannot be obtained through conventional imaging techniques.

	SPECT EP vs. Modic	SPECT EP vs. Vacuum Disc	SPECT EP vs. Pfirrmann	SPECT Facet vs. Vacuum Facet
L1-L2	r = 0.559, p < 0.001	r = 0.567, p<0.001	r = 0.509, p < 0.001	r = 0.492, p < 0.001
L2-L3	r = 0.346, p < 0.001	r = 0.306, p < 0.001	r = 0.375, p = 0.002	r = 0.270, p = 0.003
L3-L4	r = 0.329, p < 0.001	r = 0.598, p < 0.001	r = 0.526, p < 0.001	r = 0.377, p < 0.001
L4-L5	r = 0.480, p < 0.001	r = 0.500, p < 0.001	r = 0.658, p < 0.001	r = 0.400, p < 0.001
L5-S1	r = 0.496, p < 0.001	r = 0.482, p < 0.001	r = 0.541, p < 0.001	r = 0.451, p < 0.001

Table 1: Correlation Analysis (Spearman's rank-order)

	SPECT EP (OR, 95% CI)	SPECT Facet (OR, 95% CI)
Modic Changes	6.402 (3.090 -13.266) p < 0.001	-
Pfirrmann Grade (4-5)	17.273 (3.802 - 78.463) p = 0.047	-
CT Vacuum Disc	2.693 (1.300 - 5.578) p = 0.002	-
CT Vacuum Facet	-	16.300 (8.166 - 32.537) p < 0.001

Table 2: Multivariate Logistic Regression Analysis