



## Usefulness of SPECT-TC in the evaluation of chronic spinal pain: a new diagnostic tool

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### Introduction:

Imaging evaluation represents a critical part in the diagnostic process of patients with chronic spinal pain and contribute to the selection of therapeutic options. Nowadays, plain radiography, computed tomography and magnetic resonance imaging are the gold standard techniques in diagnostic imaging evaluation of chronic spinal pain.

### Objectives:

The objective of this study is to evaluate the potential usefulness of single photon emission computed tomography and computed tomography (SPECT/CT) as an imaging tool for the study of chronic spinal pain and offer an extensive pictorial review of SPECT/TC features of spinal pain generators. This imaging tool was incorporated to Clinica Vertebra, Spine and Pain Surgery Centers from November 2014 and is regularly included as an additional document in cases of complex spinal chronic pain where the usual standard imaging tools did not prove a conclusive diagnosis of spinal pain patients.

### Methods:

A extensive literature review took place to identify relevant studies evaluating the use of SPECT/CT in patients with chronic spinal pain. Studies were evaluated according to their methodology and results. In this study we describe the SPECT/TC features of different spinal pain generators associated to spinal pain and the usefulness of SPECT/TC in Clinical decision making. SPECT/TC features in facetogenic pain, discogenic pain, spinal fractures are described as well as SPECT/TC appearance of previously operated spine. Images of SPECT/TC of different pain generators of the spine were obtained from the imaging data base of our center from 2014 to 2024.

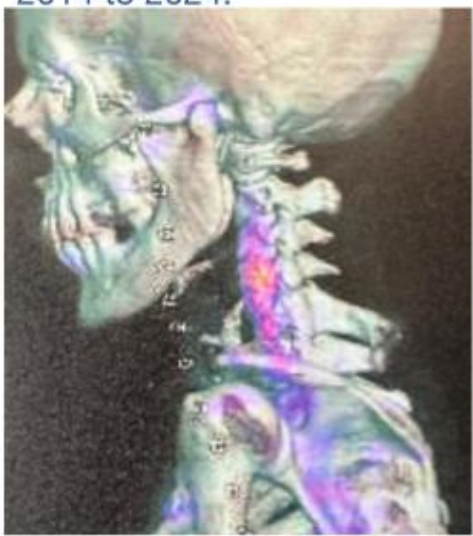


Figure 1. 3D fused single photon emission CT demonstrate increased radiotracer uptake in within bilateral C3-4 to C6-7 facet joints compatible with degenerative facet arthropathy.

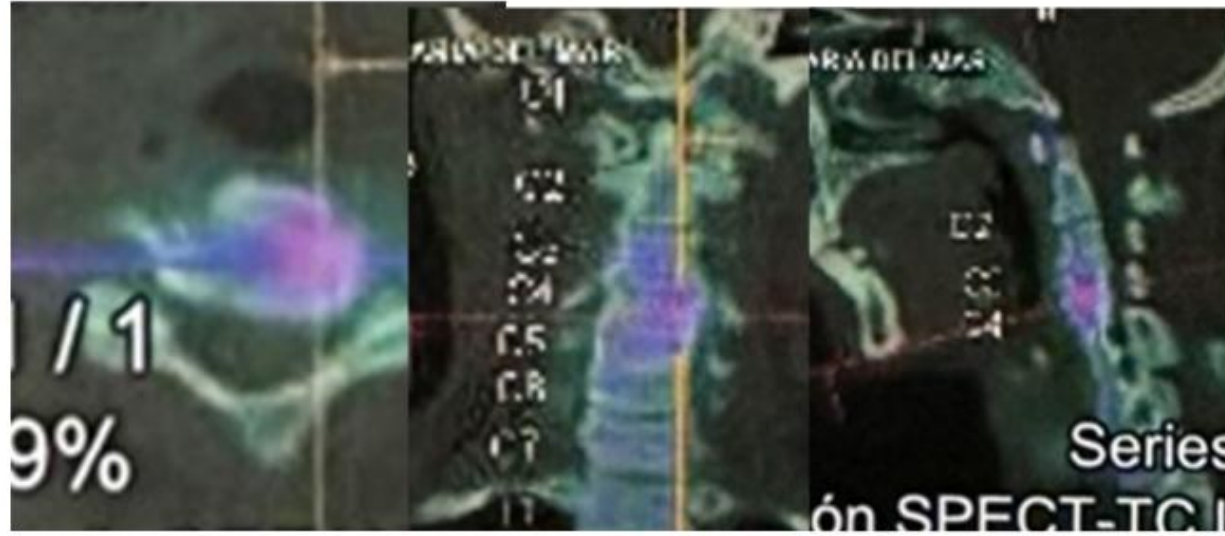


Figure 2. Fused axial, coronal and sagittal single photon emission CT with CT images demonstrated increased radiotracer uptake in the C4 to C5 disc. The patient was then referred for percutaneous C4-5 discoplasty with thermal radiofrequency and intradiscal injection of O2-O3 and LR-PRP, according to Vertebra Clinic protocol and technique.

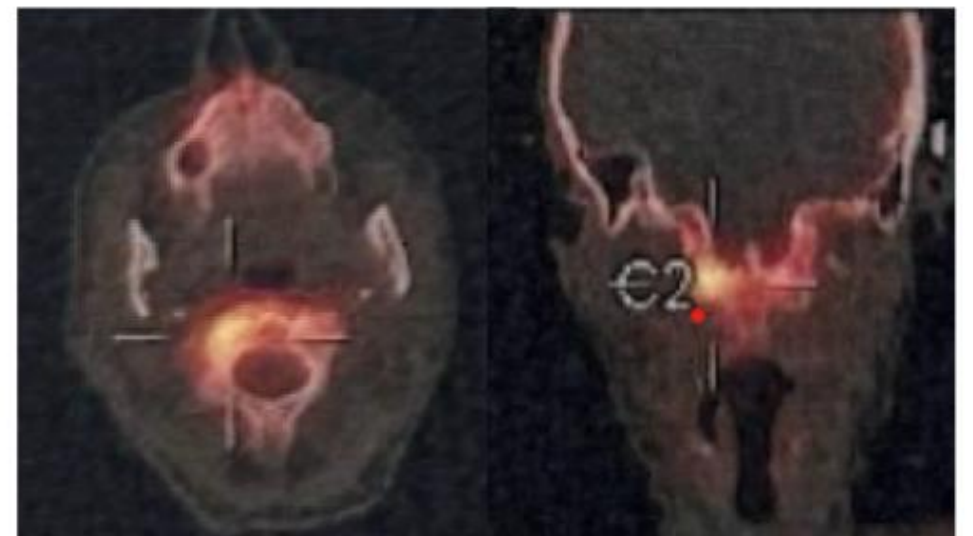


Figure 3. Axial and coronal fused single photon emission CT demonstrate increased radiotracer uptake in within right C1 to C2 facet joint compatible with degenerative facet arthropathy.

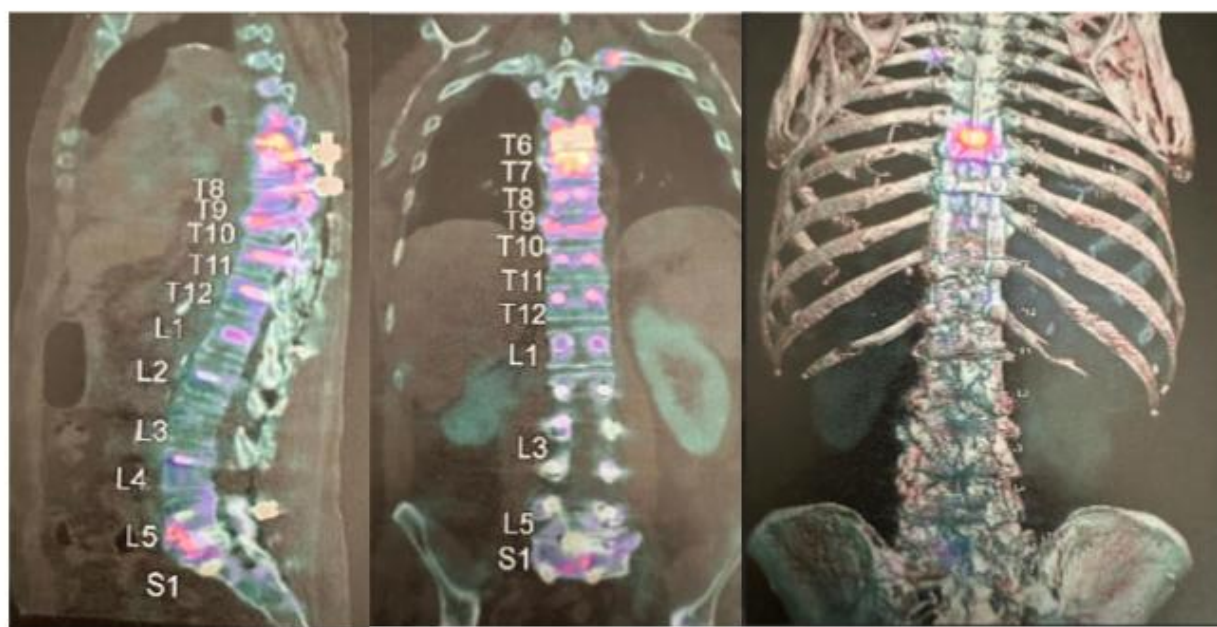


Figure 4. Sagittal, coronal and 3D fused SPECT-TC demonstrate increased radiotracer uptake at the T6-T7 vertebral bodies, which suggest symptomatic pseudarthrosis. Increased radiotracer uptake is evident at T6, T7, T8, T9, T10 and T11 level, concerning for pedicle screws loosening.

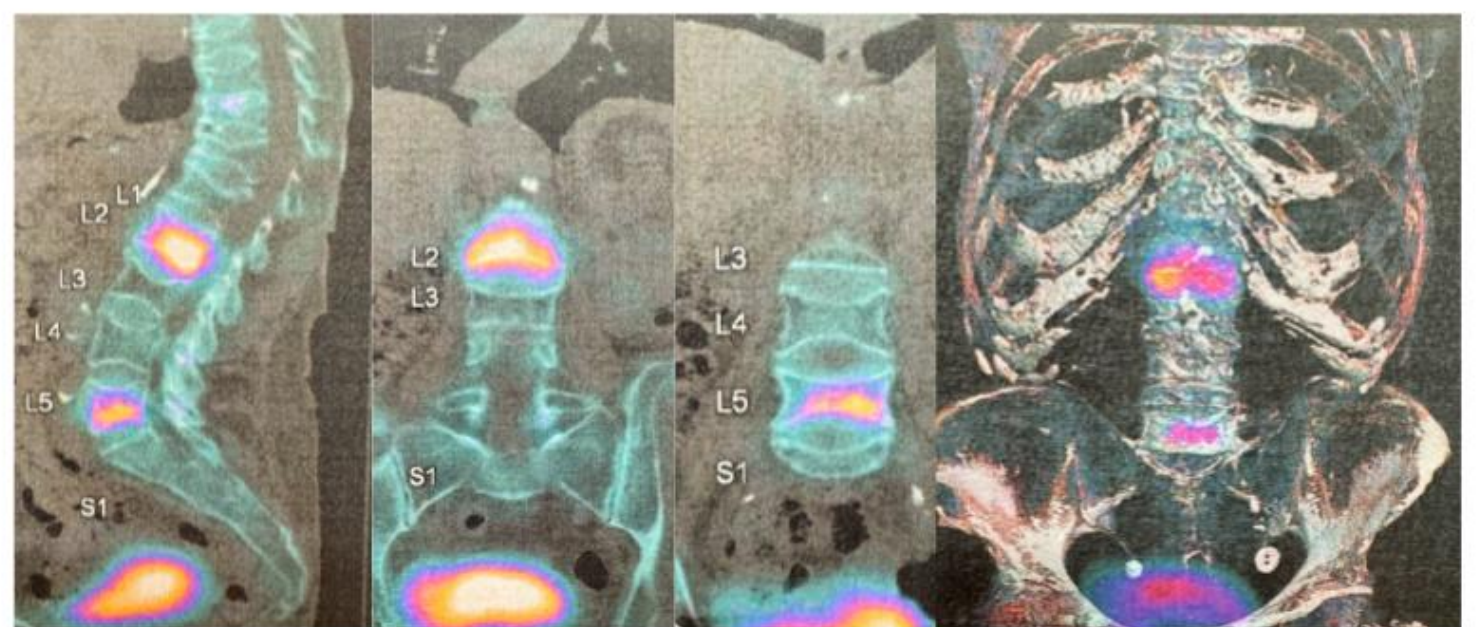


Figure 5. Sagittal, coronal, and 3D fused SPECT-TC demonstrates increased activity at the L2 and L5 vertebral bodies, compatible with unconsolidated vertebral compression fractures.

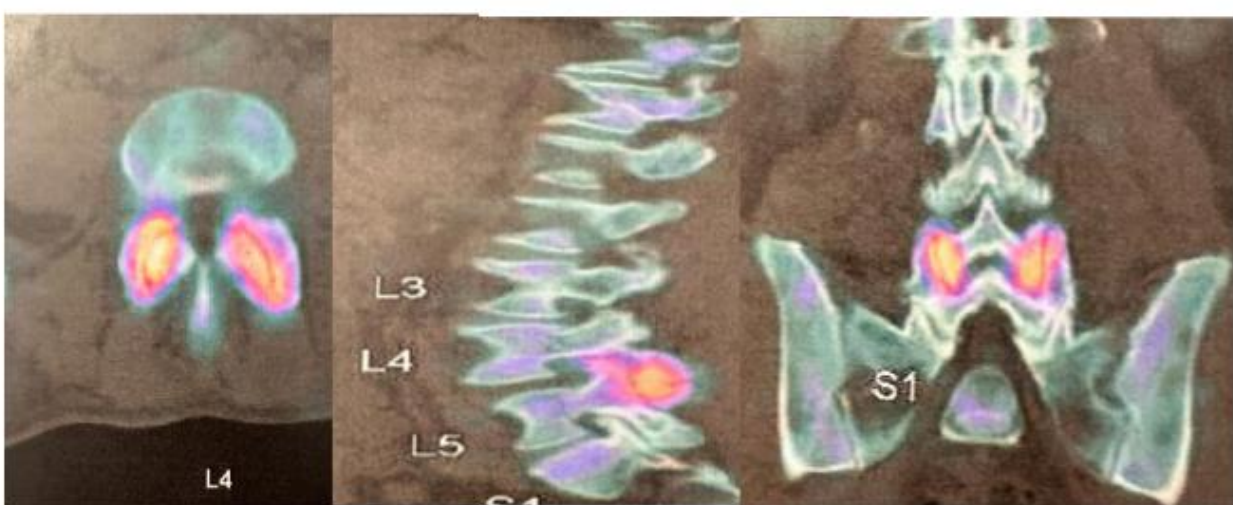


Figure 6. Fused axial, sagittal and coronal single photon emission CT with CT images demonstrate increased radiotracer uptake in within bilateral L4 to L5 facet joint with associated subchondral cysts and joint space narrowing compatible with degenerative facet arthropathy.

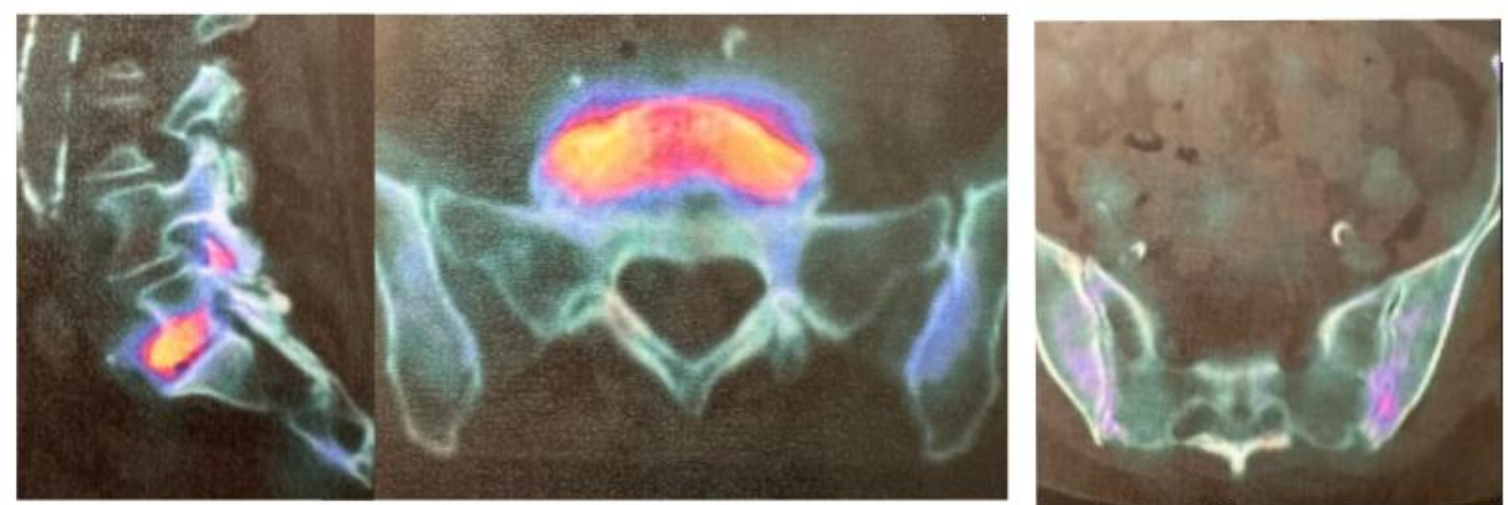


Figure 7. Single photon emission computed tomography with computed tomography findings demonstrate increased radiotracer uptake in the L5 to S1 disc. The L5 to S1 disc was determined to be the dominant pain generator, resulting in a discogenic pain pattern.

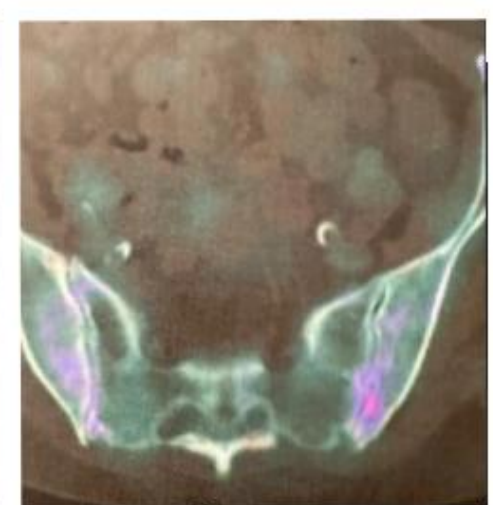


Figure 8. Axial fused SPECT-TC demonstrate increased radiotracer uptake at bilateral sacroiliac joint, concerning for sacroiliac degenerative arthropathy.

### Discussion:

Accurately identifying sources of axial pain may help guide targeted nonsurgical treatment. Bone single photon emission computed tomography with computed tomography (SPECT/CT) has emerged as a potentially useful tool in this patient population.

**Facetogenic pain** affects 15% to 41% of chronic low back pain sufferers. The potential of SPECT/CT first emerged in 2007 in a study by McDonald et al. Subsequent research by Matar et al, supported these findings. SPECT/CT's sensitivity in detecting pain generators was corroborated in a study by Ravindra et al. These findings suggest that SPECT/CT can enhance the detection of symptomatic facet joint pathology and improve operative outcomes.

According to Carragee et al, in patients with potential **discogenic pain**, a combination of discography, SPECT/CT, and MRI may enhance diagnostic specificity despite the inherent risks of discograph. Khalil demonstrated that SPECT/CT may potentially aid in establishing indications for basivertebral nerve ablation, as this seems to target the end plate of the disc in the setting of discogenic or vertebrogenic pain, but more research is needed. Al-Riyami et al, described the utility of SPECT/CT's in diagnosing pseudarthrosis and instrumentation loosening after **spinal fusion**. In a study by Heimburger et al, that included 54 patients with axial pain after lumbar fusion, SPECT/TC showed an 81% sensitivity and 83% specificity for pseudarthrosis following posterolateral fusion, as well as 100% sensitivity coupled with 60% specificity in detecting interbody pseudarthrosis. **Osteoporotic vertebral compression fractures** are a common pathology, primarily affecting older patients, and can lead to pain, disability, and kyphotic deformity. Sola et al observed that SPECT/CT can be useful in predicting the patient's response to vertebral cement augmentation. **Sacroiliac Insufficiency Fractures** are visualized as a Honda sign at SPECT/CT as stated by Seo J-Y in a study of 2021. **Sacroiliac joint dysfunction (SIJ)** is an increasingly cause of low back pain but remains difficult to accurately diagnose. Commonly used imaging studies such as RX, CT and MRI are generally not effective at differentiating SIJ dysfunction from other causes of low back pain. The gold standard for diagnosis, to date, is the response to a diagnostic injection. Cusi et al, demonstrated that SPECT/CT is able to accurately distinguish between the various sources of axial pain and therefore is an appealing supplementary study in the evaluation of SIJ dysfunction.

### Conclusions :

SPECT/CT showed to be a useful imaging technique in the evaluation of patients with chronic spinal pain especially in difficult clinical scenarios when other techniques like magnetic resonance and computed tomography are not conclusive. The implementation of the use of SPECT/TC in the diagnosis of chronic spinal pain could improve diagnostic accuracy and permits more specific treatments for the management of chronic spinal pain.