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Evaluating the role of SPECT/CT for the detection of cartilage lesions in the knee: A Systematic Review

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- Nothing to disclose

Background

Single-photon emission computerised tomography with conventional computer tomography (SPECT/CT) is an innovative imaging tool which may enhance the clinical evaluation of chondral lesions in the knee joint.

The intensity and distribution of SPECT/CT uptake tracer may offer physiological and structural insight by potentially detecting chondral lesions, or areas of inferior cartilage quality, prior to structural changes that other standard imaging modalities, such as MRI, may overlook.

Thus, SPECT/CT is particularly valuable for diagnosing and managing chondral lesions, particularly when no cartilage abnormality is visible on other modalities.

This systematic review aims to evaluate the effectiveness of SPECT/CT to identify chondral lesions in the knee joint of patients experiencing knee pain, with or without accompanying structural changes.

Methods

A systematic search was carried out using PRISMA guidelines in:

- PubMed
- Science Direct
- Web of Knowledge
- NHS NICE Databases

Eligible articles included those focusing on the diagnostic value of SPECT/CT concerning knee chondral lesions and associated knee pain.

Inclusion Criteria:

- Any English language article
- Diagnostic value of SPECT/CT
- Knee chondral lesions
- Knee pain

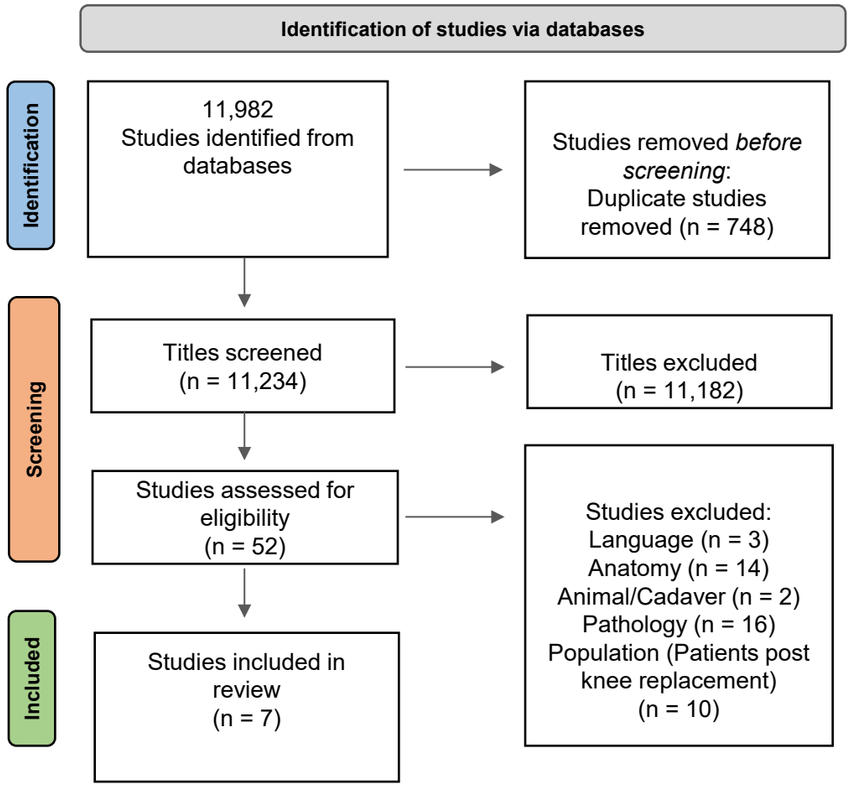
Exclusion Criteria:

- Animal studies
- Cadaver studies
- Comparator technique other than SPECT/CT
- Patients with a pathology other than knee chondral lesions

Relevant articles underwent QUADAS-2 bias assessment.

Results

- A total of 11,982 manuscripts were initially identified, from which seven studies met the inclusion criteria.
- Low bias was found for all articles according to QUADAS-2 assessment.



		Risk of Bias				Applicability		
Study Author	Study Design	Patient Selection	Index Test	Reference Standard	Flow and Timing	Patient Selection	Index Test	Reference Standard
Ammann et al [17]	PCSS	L	L	L	L	L	L	L
An et al [18]	RCS	U	L	H	L	L	L	L
Dordevic et al [20]	RCS	L	L	L	L	L	L	L
Koh et al [16]	RCS	L	L	L	L	L	L	L
Lu et al [19]	RCS	U	L	L	L	L	L	L
Maas et al [21]	RCSS	L	L	L	L	L	L	L
Ro et al [15]	RCS	L	U	U	L	L	L	L

PCSS = Prospective cross-sectional study, RCS = Retrospective cohort study, RCSS = Retrospective cross-sectional study. L= Low grade, U = Unclear grade, BS = Bone Scintigraphy. All articles have 2 or less grades of unclear bias.

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Results

Study Author	Gold Standard	Sample Size	Mean Age (y)	Sex		Primary Inclusion Criteria	Findings
				M	F		
Koh et al 2015 [16]	Clinical assessment	95	59	33	62	Knee pain	Those with tracer uptake of lesions coincided with the area of pain complaint. Lesions were found by SPECT/CT in 4 patients outside the area of complaint.
Ammann et al 2019 [17]	Arthroscopic assessment	33	61	11	22	Chronic knee pain >6 months	Tracer uptake correlated with ICRS score.
Ro et al 2015 [15]	Arthroscopic assessment	74	54	23	51	Knee pain with no known cause >8 weeks	Tracer uptake correlated with ICRS score. Higher uptake in PFJ of patients with chronic AKP is predictive of poor response to conservative management.
An et al 2021 [18]	Bone Scintigraphy	104	58.3	19	85	Knee pain	15% of lesions scored higher uptake on SPECT/CT and the total number of lesions identified was higher for SPECT/CT.
Lu et al 2018 [19]	Bone Scintigraphy	39	43	14	25	Knee pain and x-ray, BS, and SPECT/CT	SPECT/CT detected, localised, and characterised 100% of lesions, cf. BS, which detected 91%, localised 42% and characterised 52% respectively.
Dordevic et al 2016 [20]	MRI	63	49.2	42	21	At least 1 chondral lesion	SPECT/CT significantly correlated with grade and size of lesions as MRI.
Maas et al 2015 [21]	MRI	25	47.7	14	11	Chronic knee pain >6 months	Significant uptake by SPECT/CT with increasing cartilage WORMS score. SPECT/CT found increased uptake in 29 regions where MRI showed normal cartilage.

M = Male, F = Female; MRI = Magnetic Resonance Imaging; N = Number of participants; ICRS = International cartilage regeneration and joint preservation society; PFJ = Patellofemoral joint; AKP = Anterior knee pain; WORMS = Whole organ MRI scoring; BS = Bone scintigraphy.

Results

- Tracer uptake measured by SPECT/CT often aligned with the knee pain location reported by patients. In certain cases, chondral lesions were discovered by SPECT/CT in regions located away from the pain site.

- SPECT/CT uptake correlated with ICRS scores during arthroscopic evaluations of chondral lesions.

- Compared to planar imaging techniques, SPECT/CT had superior capabilities in detecting, localising, and characterising chondral lesions than bone scintigraphy.

- SPECT/CT exhibited a significant correlation with chondral lesion size and grade when compared to MRI, specifically identifying 29 regions of cartilage lesions that MRI classified as normal.

Discussion

MRI remains the gold standard for detecting chondral lesions but is limited by observer variability and a 22% misdiagnosis rate (Krakowski et al., 2021; Zhang et al., 2013).

In contrast, SPECT/CT offers objective, reproducible measurements through tracer uptake, detecting 100% of lesions and diagnosing 92% in chronic knee pain patients, compared to 38.5% identified by BS (Kim et al., 2017; Lu et al., 2018).

Notably, SPECT/CT has detected tracer uptake in 35% of knee regions appearing normal on MRI, suggesting superior sensitivity for early OA detection before MRI or radiographic changes (Maas et al., 2015; Zarringam et al., 2021).

Its ability to identify metabolic changes without visible cartilage loss highlights its diagnostic advantage, though radioactive implications remain a consideration (Hirschmann et al., 2010; Van Den Wyngaert et al., 2018).

Conclusion

- The findings suggest that SPECT/CT is a promising tool for the early detection and localisation of chondral lesions in the knee joint
- Particularly in cases where standard imaging fails to reveal chondral abnormalities or do not correlate with the patients' symptoms.
- Further research is essential to thoroughly evaluate the diagnostic capacity of SPECT/CT and to clarify its potential role in clinical decision-making regarding chondral lesions in the knee.

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