

Technical Report

Single photon emission computerized tomography (SPECT) scan–positive facet joints and other spinal structures in a hospital-wide population with spinal pain

Daoud Makki^{a,*}, Rabi Khazim^a, Abu Amar Zaidan, MBBS, MRCS^a,
Kuppuswamy Ravi, MBBS, FRCS(Orth)^a, Tagreed Toma, BCHB, FRCR^b

^aDepartment of Orthopaedics, Southend Hospital, Essex, SS0 0RY, United Kingdom

^bDepartment of Radiology, Southend Hospital, Essex, SS0 0RY, United Kingdom

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Abstract

BACKGROUND CONTEXT: The current criterion standard for zygapophyseal (facet) joint pain diagnosis is placebo-controlled triple comparative local anesthetic facet joint or medial branch blocks. Single photon emission computerized tomography (SPECT) scanning is a less invasive modality that has been widely used in patients with spinal pain for the diagnosis of facet joint arthritis. Previous studies have shown that SPECT results correlate well with response to facet joints steroid injections.

PURPOSE: To evaluate the prevalence of SPECT scan–positive facet joints and other spinal areas in different age groups in a hospital-wide population with spinal pain.

STUDY DESIGN: Retrospective study.

METHODS: This study included 534 patients who underwent a SPECT scan for spinal pain over 7.5 years in our hospital. All referrals from all doctors for any cervical or lumbar spinal pain were included, and the results were reviewed.

RESULTS: A total of 486 patients (91.1%) had at least one positive abnormality on SPECT scan; 81.3% had increased uptake in different structures and regions of the spine. This included 42.8% increased uptake in the facet joint 29.8% in the vertebral bodies/end plates, and 5.9% in sacroiliac joints. The prevalence of increased uptake in the lumbosacral and cervical spine was 44% and 37%, respectively. When patients were divided into five age groups (below 40, 40–49, 50–59, 60–69, and 70 years and older), there was a significantly higher increased prevalence in advancing age groups.

CONCLUSIONS: In a hospital-wide population with spinal pain, there is a 42.88% prevalence of increased uptake in the facet joint on SPECT. The incidence increases significantly with advancing age. SPECT can play a role in investigating patients with spinal pain. © 2010 Elsevier Inc. All rights reserved.

Keywords: Spinal pain; Zygapophyseal joints; Facet joints; SPECT scans

Introduction

Zygapophyseal (facet) joint pain (ZJP) is widely accepted, although no specific physical examination technique, laboratory test, or imaging modality has been reported as able to determine whether a joint is painful or

not. The current criterion standard for the diagnosis of ZJP is placebo-controlled triple comparative local anesthetic (LA) facet joint or medial branch blocks. As these have a limited clinical utility because of ethical and cost implications, controlled comparative LA blocks are acceptable alternative [1,2]. The patient undergoes the same block on two separate occasions but using short-acting LA on the first occasion and long-lasting LA on the second. A positive response is one in which the patient obtains complete relief of pain on each occasion, but the pain relief is short lasting on the first occasion and long lasting on the second [2].

SPECT scanning is a less invasive modality that has been widely used in patients with spinal pain for the

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* Corresponding author. Department of trauma and Orthopaedics, Tye Green Ward, Princess Alexandra Hospital, Hamstel Rd, Harlow CM201QX, United Kingdom. Tel.: (44) 127-944-4455 fax: (44) 127-982-7579.

E-mail address: daoudmakki@doctors.net.uk (D. Makki)

diagnosis of facet joint arthritis [3]. Previous studies have shown that SPECT results correlate well with response to facet joint steroid injections [4–8]. Some authors reported that, of those patients who had positive SPECT scan, 95% had improvement with facet joint injections at 1 month and 79% at 3 months [5], whereas others [4,7,8] reported 87% to 100% correlation between positive SPECT scans and facet joint injections. We are not aware of any studies reporting the prevalence of SPECT scan–positive facet joints in a hospital-wide population with spinal pain.

Although SPECT scan can suggest the diagnosis of other conditions, other investigations may be more appropriate for such conditions. SPECT scan was first used in our institution in 1997 particularly for the diagnosis of facet joint disease. However, the SPECT scan was also used for other indications, including discogenic back pain, nonunion of spinal fusion, spondylolysis, spinal infection, and tumors, to confirm acute fractures and other nonspecific spinal pain.

The aim of our study was to evaluate the prevalence of SPECT scan–positive facet joints and other spinal areas, in different age groups in a hospital-wide population with spinal pain.

Patients and methods

All cervical, thoracic, and lumbar spinal SPECT scans performed in our hospital between March 1997 and December 2004 were retrospectively reviewed. SPECT images were obtained 3 hours after the injection of 750 MBqTc-99m methylene diphosphonate. For the SPECT images, a rotating gamma camera was used equipped with a high-resolution collimator. We performed tomographic imaging through 360 degrees using a body-contoured orbit, where sixty-four 20-second projections were obtained. Almost all of the scans were reported by a radiologist with a special interest in nuclear medicine.

Scans were interpreted as positive for facet joint abnormalities when there is an increased uptake in a joint when compared with the opposite facet joint in case of a unilateral involvement, and to the ones above and below when there is a bilateral increased uptake. SPECT scan was considered negative if there was either no or minimal increase in facet joint uptake as judged by the consultant radiologist. Other spinal abnormalities related to disc spaces or vertebral bodies as well as any other nonspinal joint or structure, such as ribs, shoulder, or hip, or sacroiliac joints were recorded. Using a southend hospital performa, the results of the scan were analyzed by the Research and Audit Department of our hospital using the SPSS software (SPSS, Surrey, United Kingdom).

Results

A total number of 534 cases were reviewed. The overall results of SPECT scans are detailed in Table 1. A total of

Table 1

Single photon emission computerized tomography (SPECT) scan results including all positive and negative scans in different regions of the body

Area of uptake	Number	Percentage
Positive scans (N=486, 91.1%)		
Facet joints	229	42.8
Vertebral end plates and discs	157	29.4
Pars inter-articularis	2	0.4
Sacroiliac joint uptake	30	5.7
Costochondral uptake (total positive spinal)	16 (434)	3 (81.3)
Positive nonspinal*	52	9.8
Negative scans	48	8.9
Total	534	100

* Acromioclavicular/shoulder joint/hips and others.

486 patients (91.1%) had at least one positive abnormality on SPECT scan. A total of 434 cases (81.3%) had increased uptake in different structures and regions of the spine. This included 29.8% increased uptake in the vertebral bodies/end plates/pars interarticularis, 5.9% in sacroiliac joints, and 42.8% in the facet joints. The prevalence of increased uptake in the lumbosacral and cervical facet joints was 44% and 37%, respectively (Table 2). When patients were divided into five age groups (below 40, 40–49, 50–59, 60–69, and 70 years and older), there was a progressively significantly higher increased uptake in the older group ($p < .05$) (Table 3, Figure). There were no cases of suspected infection or tumors on SPECT scan of the spine.

Discussion

Although the suspicion of ZJP pain is a well-reported indication for investigation with SPECT scan, unlike magnetic resonance imaging (MRI), SPECT is not universally adopted as a routine investigation for spinal pain. The clinical characteristics giving suspicion of ZJP are not unique and nonspecific. Some authors have suggested some typical clinical features of ZJP [9,10], but other studies have failed to confirm such features [2,11]. The current criterion standard for the diagnosis of ZJP is placebo-controlled triple (or double) comparative LA facet joint or medial branch blocks. When clinical criteria were used as an indication for SPECT, only 38% had positive scans for increased uptake in the facet joint [5]. Similarly

Table 2

Results of single photon emission computerized tomography (SPECT) scan for facet joint disease of the spine (total number of patients 534)

	Lumbosacral spine	Cervical	Both	Total
Facet joint uptake				
Number of SPECT	389	104	41	534
Positive SPECT	173	39	17	229
Percentage	44.47	37.5	41.46	42.88

Table 3

Results of single photon emission computerized tomography (SPECT) scan for facet joint disease of the spine in relation to age (N = 534)

Facet joint uptake	Patient age, y					Total
	<40	40–49	50–59	60–69	≥70	
Number of scans	152	121	135	78	48	534
Positive results	23	53	60	55	38	229
% of positive scans	15.3	43.8	44.44	70.51	79.16	42.88

other authors have reported that of the patients with clinical characteristics suggestive of ZJP, only about one-third had a “current criterion standard” diagnosis of ZJP [12].

Only a certain percentage of arthritic facet joints are painful. Kalichman et al. [13] reported that there is no correlation between facet joint arthritis identified by computed tomography (CT) scan and low back pain in a community-based study population, and 62.76% of their population had facet joint arthritis on CT scan. Kim and Wang [14] investigated the correlation between radiographic findings on MRI scans and SPECT. They found that of four MRI facet joints’ grades likely representing a continuum of facet degeneration, from a normal to an obliterated joint, one particular subtype, Grade 2, demonstrated a high specificity for SPECT and synovial fluid increase suggestive of inflammation. Facet hypertrophy was not predictive of bone scan positivity, perhaps suggesting the protective nature of a hypertrophied facet [14]. Further studies correlating the above-reported MRI grading and SPECT with comparative LA or placebo-controlled blocks are recommended to determine if this subgroup of painful facet joints can possibly be identified by MRI or SPECT scans.

Taking into consideration that Kalichman et al. [13] identified facet joint arthritis by CT scan, whereas our cases were identified by SPECT, and although their population is community based whereas all our patients had spinal pain, both studies confirm similar trend of higher prevalence in advancing age groups. They reported an incidence of 24% in those younger than 40 years, 44.7% in those aged between 40 and 49 years, 74.2% in those aged between 50 and 59 years, 89.2% in those aged between 60 and 69

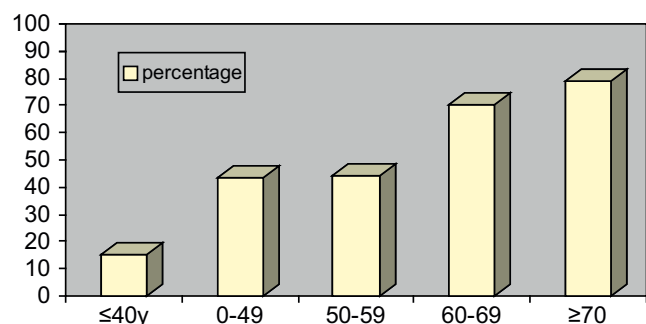


Figure. Results of SPECT scan in relation to age groups; both the number of scans and positive results are shown.

years, and 69.2% in patients aged 70 years and above. This is compared with 15.13%, 43.8%, 44.44%, 70.51%, and 79.16% in our cases, respectively.

Of our patients 29.8% had increased uptake in the vertebral bodies/end plates. A previous study has reported that of 38 patients with Modic changes on MRI, 37 had SPECT-positive end plates, whereas of 47 patients with SPECT-positive end plate changes, 37 had Type 1 or Type 2 changes on MRI. The authors proposed that SPECT-positive end plates are related to end plates marrow changes, and some of these changes may be delineated on SPECT before Modic changes are observed on MRI [15]. Further studies are recommended in this regard.

There have been different estimates of the prevalence of ZJP. On the basis of controlled diagnostic blocks, the prevalence of lumbar ZJP in different populations (chronic back pain, rheumatology, or pain clinics) ranges from 15% to 40% [11,16–18]. This is compared with 44% SPECT scan-positive lumbar facet joints in our population. To our knowledge, no previous study has reported the prevalence of SPECT scan-positive cervical facet joints. The prevalence in our population (37%) is similar to the prevalence of cervical ZJP (39%) reported in a pain management clinic based on facet blocks [16].

It can be argued that reviewing our patients’ MRI results might have helped identifying the cause of pain [19], particularly in SPECT-negative cases. Given the lack of correlation between MRI findings and clinical findings, we felt that analyzing MRI data was not useful.

We note that most SPECT scans in this study were reported by a single radiologist with a special interest in nuclear medicine. However, the reproducibility of the interpretation of SPECT-positive facet joints or other spinal structures is questioned. A previous study on interobserver variability in interpretation of the presence of a lesion on SPECT reported only moderate agreement between examiners (kappa value of 0.460) [20]. Further studies and perhaps more objective and quantifiable criteria or techniques for determining SPECT-positive abnormalities are recommended.

A drawback of our study is that, although all our patients had spinal pain, they were not randomly chosen for investigation with SPECT scan. Some patients may have had clinical features or previous investigations (such as radiographs) that would increase the likelihood of having SPECT scan-positive abnormalities. Others would have had such a convincing evidence of an abnormality that SPECT scan was felt unnecessary and those patients were not included in our population, thereby decreasing the prevalence of SPECT scan-positive abnormalities. Therefore, the prevalence of SPECT scan-positive facet joints and other spinal areas in our study is specific to those patients felt appropriate for investigation by SPECT by all our hospital specialists who manage patients with spinal pain, including pain specialists, rheumatologists, and orthopedic and spinal surgeons, and does not represent the prevalence

in all patients, or specific groups of patients, with spinal pain. Furthermore, as we have not correlated the SPECT-positive findings with clinical parameters, such as the location, side of pain, or response to comparative LA blocks, the reported abnormalities are radiological abnormalities, some of which may be incidental and not clinically relevant.

We felt it would be unethical to conduct a study of SPECT scan in totally asymptomatic people to compare the prevalence of SPECT-positive facet joints between patients with spinal pain and those who are asymptomatic, as this would involve exposing people to unnecessary radiation.

Most of the spinal pain cases are self-limiting and do not need radiological investigations or invasive treatment. SPECT scanning may be used for research purposes, particularly in studying the outcomes of different treatment options for “facet joint pain;” indications for surgery in spinal pain such as fusion and disc or facet joint replacement; and also in assessing causes for adverse outcomes after such treatments. This is particularly given that facet joint pain is reported as the most frequent cause of bad outcome in cases of total lumbar disc replacement [21].

Although SPECT scans predict relief of pain after intra-articular facet joint steroid injections [4–8], this is not the same as diagnosing the facet joint as a cause of pain. Placebo response, nonspecific response to steroids, extravasation of the injectate outside the facet joint, and other factors can lead to a positive response to steroids [12]. Conversely, some patients with facet joint pain may not respond to steroid injections. Radiofrequency neurotomy (denervation) is indicated in patients who had a positive response to comparative LA medial branch blocks [2]. As no correlation has yet been reported between SPECT and comparative LA blocks, we do not recommend using positive facet joints on SPECT as an indication for facet joints’ denervation.

However, we believe SPECT scan can be useful if intra-articular facet joint steroid injections are considered. Although the utility of these injections is questioned [2], it is still a frequently used procedure for management of spinal pain [22,23]. A randomized controlled study (but not placebo controlled) comparing facet joints and medial branch blocks in patients with SPECT-positive facet joints reported significantly better pain relief and decreased disability on Oswestry Disability Index at 12 weeks in the group who had facet joints compared with medial branch blocks [6]. As SPECT can select patients who would respond to steroid injections, a significant proportion of patients suspected of having ZJP who would otherwise have facet joint steroid or LA injections can avoid unnecessary invasive procedures if they have SPECT-negative facet joints: about two-thirds of patients in previous studies [4,8] and 57% of our cases. Pneumáticos et al. [8] randomized patients who were scheduled to have facet joint steroid injections into two groups: one had

SPECT and one did not. The patient who had SPECT-positive facet joint had injection at the levels where abnormalities were identified on the scans, whereas those who had negative scans or were randomized not to have a scan were injected at the levels identified by the referring physician; 86.5% of their patients who had negative scans (51% of their patients) had no improvement with injections and could have avoided the unnecessary injections had they had the scan. SPECT can also help determine the exact joints to inject. In the study of Pneumáticos et al. study [8], the number of joints injected in those with positive scans was decreased to 27 from 60, which was the number originally planned by the referring physician.

SPECT can identify other causes of pain (rather than the suspected facets joint pain). For example, 5.7% of our patients had increased sacroiliac joint uptake in, most of whom were eventually diagnosed with spondyloarthropathy. By having the scan, a significant delay in diagnosis can be avoided and medical treatment can be started earlier.

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