Performance of ^{18}F-sodium fluoride positron emission tomography with computed tomography to assess inflammatory and structural sacroiliitis on magnetic resonance imaging in axial spondyloarthritis

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Abstract

Objective

To assess increased sacroiliac joint (SIJ) uptake on ^{18}F-NaF PET/CT according to a qualitative and quantitative approach and to compare with MRI SIJ assessments for structural and inflammatory sacroiliitis in a population of 23 patients with spondyloarthritis (SpA) (IDRCB: 2012-A00568-35; ClinicalTrials.gov: NCT 02869100).

Methods

This single-center prospective study included 23 patients with active SpA according to the ASAS and/or modified NY criteria. All patients had a pelvic AP-view radiograph, MRI of the SIJ and ^{18}F-NaF PET/CT examinations within a month, which were analysed by three blinded readers. For MRI data, the SIJs were assessed according to the ASAS criteria and SPARCC method for scoring structural lesions (erosion, sclerosis, fat metaplasia, backfill and ankylosis) and inflammation. On the ^{18}F-NaF PET, the SIJs were scored according to a slice-by-slice approach. Abnormal uptake was assessed using a qualitative method inspired by the ASAS criteria and two quantitative approaches (the PET-activity score according to the SPARCC method and the maximum standardised uptake value (SUVmax) for each SIJ).

Results

Structural sacroiliitis was observed on 7 radiographs and 15 MRIs. 10 MRIs showed inflammatory sacroiliitis (mean SPARCC 18.7). Twenty patients had a positive PET with a mean PET-activity score of 18.2 (±8.7). The mean SUVmax for a positive PET was 1.78 vs. 1.45 for a negative one. The inter-reader reliability was good for the PET activity score (ICC= 0.56 [IC-95: 0.32; 0.76]) and good to excellent for the SUVmax (ICC=0.70–0.90 [IC-95: 0.41; 0.96]). According to a binary approach, a positive PET was not correlated with a positive MRI for structural sacroiliitis. The PET-activity score (r=0.61, p=0.001) and SUVmax (r=0.56, p=0.004) were correlated with the SPARCC inflammation score but not with structural sacroiliitis or for SPARCC structural lesions.

Conclusion

Abnormal uptake by the SIJ on ^{18}F-NaF PET is more frequent (87.0%) than inflammatory (43.5%) and structural sacroiliitis (65.2%) on MRI in a population of SpA patients. The PET activity score and SUVmax had good correlations with inflammatory sacroiliitis but not with structural lesions on MRI.

Key words

spondyloarthritis, structural sacroiliitis, SPARCC MRI SIJ inflammation, positron emission tomography

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Introduction

Spondyloarthritis (SpA) is a group of chronic inflammatory rheumatic diseases that mainly affect the axial skeleton as well as the peripheral joints and enthesis (1–5). The modified New York criteria define ankylosing spondylitis as the association of clinical criteria with radiological sacroiliitis (at least grade 2 bilateral or grade 3 unilateral) (6). Since 2009, diagnosis of axial SpA has been based on the ASAS classification criteria and can be made without radiological sacroiliitis, if sacroiliitis is detected on MRI, corresponding to the presence of bone marrow oedema on STIR sequences (7, 8). This inflammation can be detected before structural changes, which allows for an earlier diagnosis of axial SpA. Furthermore, it has been shown that syndesmophytes seem to preferentially develop at vertebral corners where both fatty lesions and bone marrow oedema are present (9-11). In fact, according to different studies, 57.4 to 94% of syndesmophytes develop in vertebral units without active inflammation (12-14). Since the pathophysiological mechanisms leading to the syndesmophyte formation are not clearly identified on MRI, it appears relevant to evaluate new imaging techniques dedicated to bone remodeling. The diagnostic potential of nuclear imaging with Positron Emission Tomography (PET) has been investigated in several inflammatory diseases, such as polymyalgia rheumatica, vasculitis, rheumatoid arthritis and SpA (15). The relevance of PET imaging depends on the radiotracer used, and in axial SpA, Bruijnen and colleagues showed that the activity is better reflected by bone formation (using the ^{18}F-fluorid radiotracer, which shows osteoblastic activity) rather than inflammation (with ^{18}F-FDG and ^{11}C-PK11195, showing inflammation by glucose metabolism and neutrophil recruitment) (16–18). In fact, recent studies on ^{18}F-fluoride PET have shown the potential for this technique to be used in the diagnosis of sacroiliitis (19, 20). In the SIJ, the ^{18}F-fluoride uptake is moderately associated with inflammatory lesions but not with structural damage on MRI (21) in a small sample of AS patients. The association between radiotracer uptake and the structural lesions on MRI has not yet been evaluated.

The aim of our study was to compare increased sacroiliac joint (SIJ) uptake on ^{18}F-Fluoride Sodium (^{18}F-NaF) PET/ CT with inflammatory lesions and structural damage on MRI according to a qualitative and quantitative approach in patients with axial SpA.

Patients and methods

Patients

This single-center prospective study was conducted on 23 patients with axial or mixed SpA who were between the ages of 18 and 45 when the diagnosis was made, according to the ASAS or modified New York criteria. These patients were recruited at our institute.

The inclusion criteria were the following: active SpA (BASDAI ≥4 and/or in NSAID treatment failure) and with inflammation in the spine (at least three inflammatory vertebral corners) and/or the SIJ (inflammatory sacroiliitis according to ASAS criteria). After providing this information, the patients were included and provided informed consent (IDRCB: 2012-A00568-35; ClinicalTrials.gov: NCT 02869100). ^{18}F-NaF PET/CT and MRI were performed within a month. In order, not to interfere with the results of ^{18}F-NaF PET, the treatment could not be changed until between MRI and PET acquisitions.

The exclusion criteria as related to the realisation of PET/CT were the following: a confirmed or suspected ongoing pregnancy or breastfeeding, kidney failure with creatinine clearance under 60 mL/min, previous or current chronic alcoholism or drug addiction, psychiatric disease, severe comorbidities and a legal protection measure.

The following data were recorded: age, tobacco use, familial history, disease duration, extra-articular involvement, treatment, BASDAI, BASFI, BASMI, ASDAS and biologic parameters (HLA-B27, C reactive protein (CRP), erythrocyte sedimentation rate (ESR), creatinine and creatinine clearance).

All patients underwent a conventional pelvic radiograph and MRI dedicated to the SIJ along with a ^{18}F-NaF PET/CT within a month.

Imaging and scoring

• *Conventional radiography*

Anteroposterior radiography of the pelvis was completed and analysed according to the New York modified criteria by one rheumatologist who defined the presence or absence of sacroiliitis.

• *MRI*

The MRI centered on the SIJ was completed on a 3T MRI machine (Signa HDxT MR 750W, GE Healthcare) with a matrix of 416x320. The images were reconstructed in the semicoronal plane parallel to the superior border of the sacrum. This plan permitted to assess the synovial compartment according to the SPARCC MRI SIJ inflammation score. Following sequences were performed: T1-weighted (T1WS) (TR 400 to 600 ms; TE <20 ms, ETL 3) and T2-weighted sequences with fat suppression (T2WSFS) (TR 3000 ms, TE >65 ms, ETL 28). The slice thickness was 3.5 mm with a gap of 0.5 mm. The SIJ exam was performed on approximately 20 slices for a complete exploration of the SIJ.

• *^{18}F-NaF PET/CT*

The examination was started 60 minutes after direct intravenous injection of 4 MBq/kg of ^{18}F-NaF using a hybrid imaging PET/CT Biograph 6 (SIEMENS, Knoxville, TN). First, a scan was performed using a true whole body field of view without contrast agent (intensity 130 kV for 80 mAs, 0.6 s of tube rotation time, cuts of 3 mm, and pitch of 1.5). Second, the PET acquisition was also performed with a true whole body field of view with 9–12 bed positions for a complete examination of 20 to 30 minutes. The image reconstruction was done using an iterative method (3 iterations, 8 subsets, 168x168 matrix with zoom 1, Gaussian filter and 5.0 mm FWHM) before being displayed on a Leonardo® workstation (SIEMENS, Knoxville, TN). PET analysis of the SIJ was done using a slice thickness of 5 mm.

Scoring method

• *Conventional radiography*

Conventional radiographies were analysed according to the modified New York criteria to define structural sacroiliitis (at least bilateral grade 2 or unilateral grade 3).

• *MRI*

MRI inflammatory SIJ assessment: First, the presence of inflammation was assessed on a binary approach according to ASAS criteria (7).

Second, inflammation was scored according to the SPARCC MRI SIJ inflammation score (22) in consecutive slices on a dichotomous basis (present/absent) on the entire cartilaginous part of the SIJ. The final score was the sum of the scores for all of the slices, which could vary from 0 to 8 for each slice.

The presence of structural lesions and inflammation was retained if it was scored by at least two readers, and the mean score among the three readers was calculated. Both structural and inflammatory assessments on MRI were scored independently by two rheumatologists and one radiologist blindly on a website (*carearthritis.com*) after anonymisation and randomisation.

MRI Structural SIJ assessment: First, diagnosis of structural sacroiliitis was performed based on the presence of erosion (interruption of the sacral or iliac cortical bone if present on at least two consecutive slices) and/or ankylosis (partial or complete bone bridge present on at least two consecutive slices) on the cartilaginous part of the sacroiliac joint. Sclerosis was defined as low-intensity or signal-free bands by T1WSE sequences that should extend at least 5 mm from the SI joint space. Fat metaplasia was defined as a homogeneous T1W signal across the lesion that must extend more than 1 cm in depth from the joint surface. Backfill was defined as a complete loss of the iliac or sacral cortical bone and increased T1WSE signal that is clearly demarcated from adjacent normal marrow by irregular dark signal reflecting sclerosis at the border of the eroded bone (7, 14, 28).

Second, a score for structural lesions of the SIJ was established using the SpA Research Consortium of Canada (SPARCC) for MRI SIJ structural score (28). The most anterior slice was defined as a visible joint ≥1 cm in vertical height. When the vertical height was less than 3 cm, the SIJ was defined as having only 2 quadrants (upper iliac and upper sacrum), whereas a visible joint ≥3 cm in vertical height was defined as having 4 quadrants (upper iliac, lower iliac, upper sacrum and lower sacrum). At the posterior aspect of the SIJ, each quadrant was assessed individually until <1 cm of vertical height was visible when it was no longer scored. Each SIJ was divided into these four quadrants for erosions and fatty lesion or into two halves for ankylosis and backfill (upper and lower). All lesions are scored dichotomously (present/not present) according to validated definitions. Erosions, sclerosis and fat metaplasia are assessed per SI joint quadrant. Backfill and ankylosis are assessed per joint half (upper *vs*. lower)]. The readers scored the lesions on all of the quadrants for each slice on a dichotomous basis (present/absent) with the slice scores for erosion, sclerosis, fat metaplasia varying from 0 to 8 and for backfill, ankylosis varying from 0 to 4, respectively. The final score was the sum of the scores for all of the slices.

• *^{18}F-NaF PET/CT*

The analysis was blinded from clinical data, x-ray and MRI. The SIJ assessment was made by three readers (two nuclear physicians (PO, FB) and one rheumatologist (RO)). The signal was considered abnormal if it was higher than the signal in the centre of the sacrum (S2).

First, a qualitative assessment was conducted on the articular part of the SIJ based on an adaptation from the ASAS criteria for MRI. The exam was considered positive if there was unilateral uptake on two consecutives slices or bilateral uptake on one slice.

Second, a quantitative assessment was conducted using two methods:

1) The PET activity score was calculated based on the SPARCC MRI SIJ inflammation score method: each SIJ was divided into the same four quadrants, and the abnormal uptake was scored in each quadrant for each slice on a dichotomous basis (present/absent). The final score was the sum of the scores for all slices.
2) The Maximum Standardised Uptake Value (SUVmax) was measured

slice-by-slice for each SIJ, and the highest SUVmax value was considered for each SIJ. The ratio between the SUVmax for each SIJ and the SUVmax in the centre of the sacrum (S2) was calculated (SUVmax SIJ/sacrum).

As for MRIs, the presence of increased uptake was retained if it was scored by at least two readers, and the mean score among the three readers was calculated for the quantitative assessments. The exams were scored independently by two nuclear physicians and one rheumatologist blindly after anonymisation and randomisation

Statistical analysis

The intensity or quality of the agreement between the inflammatory and structural sites in MRI and ^{18}F-NaF PET uptake was done by Kappa concordance coefficients. To compare qualitative variables, Fisher's test was carried out, and for quantitative variables, Student's *t*-test was used, as the data were normally distributed. Statistical analysis was performed using SAS 9.3 software.

Results

The characteristics of the population are detailed in Table I. Seven patients were classified with structural sacroiliitis on radiography. Among the 23 patients with active SpA, twenty (87%) presented a BASDAI ≥4, and the three other patients were undergoing NSAID treatment failure or had a contraindication for NSAIDs. Moreover, 52.2% of the patients presented with biological inflammation. After the study, eighteen patients (78.3%) benefitted from TNF blocker therapy.

Imaging analysis

On MRI, ten cases of inflammatory sacroiliitis were recognised with a mean inflammation score (SPARCC) of 18.7±9.4. There were two unilateral and 8 bilateral inflammatory sacroiliitis. The inter-reader reliability was moderate for the diagnosis of sacroiliitis (ICC[IC95] = 0.53[0.41; 0.64]) and excellent for the scoring of inflammation (ICC[IC95] = 0.95[0.90; 0.98]).

On MRI, fifteen cases of structural sacroiliitis were recognised with erosions

Table I. Characteristics of the population (23 patients).

	n	Median	Mean [SD]
Clinical characteristics			
Sex: male	10 (43.5%)		
Age (years)			44.2 [±9.78]
Symptom duration (years)			7.7 [±8.5]
Axial involvement	12 (52.2%)		
Tobacco use	16 (70%)		
Treatment			
NSAIDs	1 (78.3%)		
TNF blockers*	4 (17.4%)		
Biological results			
Sedimentation rate (mm at the first hour)		14	23.3 [±22.6]
CRP (mg/mL)		8	14.4 [±20.6]
ASAS criteria			
HLA-B27	7 (30.4%)		
Arthritis	9 (39.1%)		
Enthesitis	8 (38.8%)		
Uveitis	2 (8.7%)		
Dactylitis	2 (8.7%)		
Psoriasis	6 (26.1%)		
Inflammatory bowel disease	3 (13.0%)		
Familial history	4 (17.4%)		
Inflammatory back pain	22 (95.7%)		
Good response to NSAIDs	11 (47.8%)		
Biological inflammation (CRP > 5 mg/L)	12 (52.2%)		
Clinical evaluation scores**			
BASFI		61.5	59.3 [±23.0]
BASDAI		5.88	5.45 [±2.57]
BASMI		3	2.9 [±2.0]
ASDAS		3	3.3 [±0.9]

*Anti-TNF: stopped 3 months before the MRI.
**BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; BASFI: Bath Ankylosing Spondylitis Activity Functional Index; BASMI: Bath Ankylosing Metrology Index; ASDAS: Ankylosing Spondylitis Disease Activity Score.

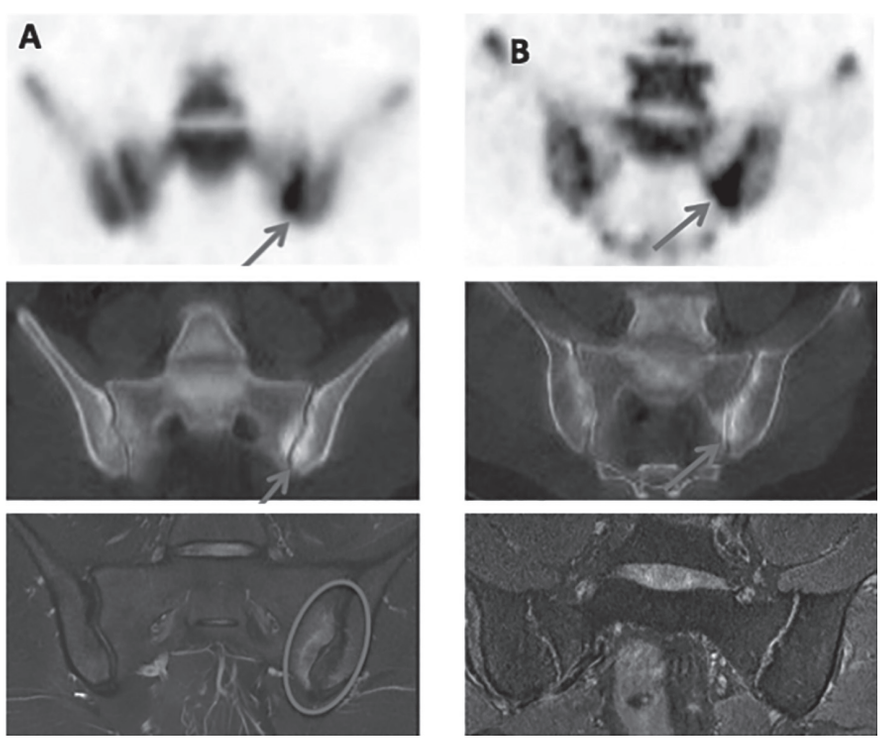

Fig. 1. Concordance (**A**) and discordance (**B**) between a positive PET and inflammatory sacroiliitis.

present on fourteen exams (mean score of 7.5±3.79) and ankyloses on three exams (mean score of 5.6±5.8), two of them had both lesions. There were 6 unilateral and 9 bilateral structural sacroiliitis. The inter-reader reliability was excellent for the scoring of erosions (ICC[IC95] = 0.72[0.53; 0.86]) and the scoring of ankyloses (ICC[IC95] = 0.86[0.74; 0.93]. The inter-reader reliability were excellent for the presence of fat metaplasia (ICC[IC95] 0.87[0.75; 0.94]) and sclerosis (ICC[IC95] 0.80[0.64; 0.90] and moderate for backfill (ICC[IC95] 0.48[0.23; 0.71]).

Twenty ^{18}F-NaF PET/CT exams were positive with a mean activity score of 18.2±8.7. There were 5 unilateral and 15 bilateral abnormal SIJ uptakes. The SUVmax SIJ/sacrum was 1.78±0.35 for positive exams and 1.45±0.66 for negative ones. The inter-reader reliability was low for the diagnosis of sacroiliitis (CKM[IC95] = 0.29[0.18; 0.3971]) and moderate for the activity score (ICC[IC95] = 0.56[0.32; 0.76]). For the SUVmax SIJ/sacrum ratio, the inter-reader reliability was good for the right SIJ (ICC[IC95] = 0.70[0.41; 0.86]) and excellent for the left SIJ (ICC[IC95] = 0.90[0.78; 0.96]).

Comparison between ^{18}F-NaF PET/CT and MRI for inflammatory sacroiliitis (Fig. 1)

There was no significant correlation between a positive PET and inflammatory sacroiliitis on MRI on a binary approach (p=0.2). All three negative PET scans were also negative on MRI, but only ten of the positive PET scans were positive on MRI, whereas the other ten were negative.

For quantitative assessments, there was a significant correlation between the PET activity score and the inflammation score (ICC[IC95] = 0.61[0.26; 0.82]; p=0.001) and between the SUVmax SIJ/sacrum ratio and the inflammation score (CC[IC95] = 0.56[0.19; 0.79]; p=0.004).

Comparison between ^{18}F-NaF PET/CT and MRI for structural sacroiliitis (Fig. 2)

On a binary approach, there was no significant correlation between a positive PET and structural sacroiliitis on MRI (p=0.26). Among the twenty positive PET cases, there were 10 positive and 10 negative MRI. 3 PET scans were negative, one with a positive MRI and two others with negative MRI.

For quantitative assessments, there was also no significant correlation between the PET activity score and MRI structural damages; erosion scores (ICC[IC95] = 0.37[-0.05; 0.67]; p=0.07), backfill (ICC[IC95] =0.22[-0.21; 0.58]; p=0.31), fat metaplasia (ICC[IC95] = 0.22[-0.21; 0.58]; p=0.30), sclerosis(ICC[IC95] = 0.36[-0.07; 0.66]; p=0.09) and ankylosis (ICC[IC95] = 0.02[-0.4; 0.43]; p=0.93). Similarly, the SUV-max SIJ/sacrum ratio was not correlated with the erosion scores (ICC[IC95] = 0.34[-0.09; 0.65]; p=0.1) or ankylosis (ICC[IC95] = -0.02[-0.56; 0.23]; p=0.56).

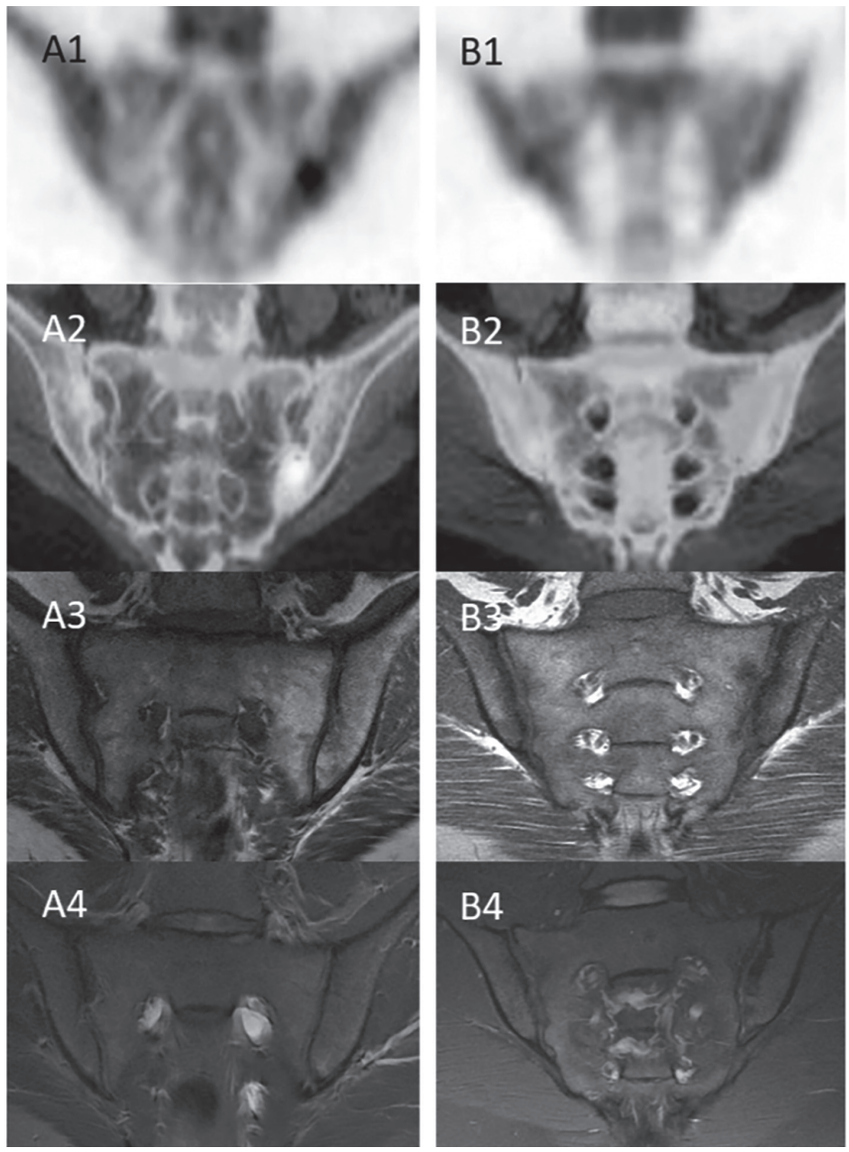

Fig. 2. Two examples of discordance between PET/CT and MRI. On figure **A1** and **A2**: a patient with increased NaF uptakes on left SIJ without structural (**A3**) or inflammatory (**A4**) SIJ involvement. On figure **B3** and **B4**: a patient with erosion and sclerosis without increased NaF uptakes (**B1** and **B2**)

Comparison between ^{18}F-NaF PET/CT and clinical and biological parameters

The PET activity score was only correlated inversely with BASDAI (CC[IC95] = -0.44[-0.72; -0.04]; p=0.03) and BASFI (CC[IC95] = -0.48[-0.74; -0.08]; p=0.02), but not with BASMI (p=0.5), ASDAS (p=0.9) or biological inflammation (p=0.5).

The SUVmax SIJ/sacrum ratio was not correlated with any of the clinical or biological parameters.

Table II. Comparison between radiographic and non-radiographic SpA.

Radiographic sacroiliitis	Positive (n=7)	Negative (n=16)
^{18}F-NaF PET/CT		
Positive (n)	7 (100%)	13 (81.2%)
PET activity score (mean)	25.1 ± 8.9	11.8 ± 8.8
SUVmax SIJ/S (mean)	2.1 ± 1.1	1.6 ± 0.4
Structural MRI		
Structural sacroiliitis (n)	7 (100%)	8 (50%)
Erosion score (mean)	10.7 ± 3.9	1.9 ± 2.2
Ankylosis score (mean)	0.4 ± 05	1.3 ± 2.4
Sclerosis score (mean)	6.5 ± 6.5	1.6 ± 2.2
Fat Metaplasia score (mean)	10.3 ± 6.3	3.7 ± 5.5
Backfill score (mean)	3.1 ± 3.1	0.9 ± 1.6
Inflammatory MRI		
Inflammatory sacroiliitis (n)	6 (85.7%)	7(43.7%)
Inflammation score (mean)	22.3 ± 13.4	10.2 ± 4.9

^{18}F-NaF PET/CT in radiographic vs. non-radiographic SpA (Table II)

Among the seven patients with radiographic sacroiliitis, all of them presented both a positive PET and structural sacroiliitis on MRI. Six of these patients had inflammatory sacroiliitis on MRI. For the sixteen patients without radiographic damage; eight presented structural sacroiliitis on MRI, seven had inflammatory sacroiliitis and thirteen had a positive PET scan. In this population, the PET activity score was higher than that for patients without radiographic sacroiliitis (25.1±9 *vs*. 11.8±8.8, p=0.007).

Discussion

This study evaluating the performance of ^{18}F-NaF PET/CT for the diagnosis of sacroiliitis in a population of axial SpA showed that there were twice as many positive PET scans as there were MRI structural and inflammatory damages. This finding suggests that ^{18}F-NaF PET may be more sensitive than MRI for the detection of inflammatory and/or structural sacroiliitis by detecting early or scar lesions not visible on MRI.

We found a significant correlation between both the PET activity score and the SUVmax SIJ/sacrum ratio and the inflammation score on MRI. The concordance between ^{18}F-NaF PET and MRI has also already been evaluated in different studies. Buchbender and colleagues (23) used hybrid ^{18}F-Fluoride PET/MRI to show that bone marrow oedema (BME) on vertebral corners detected on MRI is associated with osteoblastic activity, while the combination of BME and fat deposition showed the highest ^{18}F-F uptake. Fischer and colleagues (21) found that the correlation between the uptake detected on ^{18}F PET and the inflammation on MRI was moderate for the SIJ (kappa=0.64) and poor for the spine (kappa=0.25). To explain these results, they suggested that ^{18}F PET/CT might be able to detect the anabolic repair process leading to new bone formation regardless of the definite pathophysiological pathway.

In our study, there was no correlation between ^{18}F-NaF PET and MRI for structural sacro-iliitis. Buchbender and colleagues already demonstrated the absence of a correlation between the ^{18}F-NaF PET uptake and the presence of erosions, ankylosis or sclerosis but only on MRI (23). These results reinforce the idea that PET imaging can detect early bone remodeling processes before erosions or ankylosis are present, a cross-sectional evaluation will be necessary to confirm this hypothesis

In a recent study, biopsy procedures were used to collect material from PET-positive lesions in the spine for immunohistochemistry. These PET-positive lesions corresponded to osteoid formation and osteoclasts along with cell infiltrates in areas with both bone and connective tissue, which were largely absent in PET-negative lesions (24). This study also showed that ^{18}F-NaF PET/CT may detect changes in bone formation in ankylosing spondylitis (AS) during treatment, as one-third of the PET-positive lesions in the spine disappeared after 12 weeks of TNF-blocker treatment in their population of twelve patients with AS.

The main strength of our study lies in its strong methodology. In fact, we based our results on a analysis of three different readers for MRI and ^{18}F-NaF PET/CT. In other studies, evaluating the performance of PET, the analysis of the imaging techniques was made by only one or two readers. We found that the inter-reader correlation for the qualitative assessment of PET was mediocre, which suggests that a validation by three readers, with an agreement of at least two readers, seems to be more appropriate. Moreover, in previous studies, the PET analysis was based only on a qualitative analysis (18, 21, 25) and/or on the SUVmax (20, 23), but an activity score has never been used, which may permit a better evaluation of the SIJ. This evaluation by the SUV and a semi-quantitative score makes it possible to take into account the intensity and the spatial extent of the sacroiliac abnormalities. Indeed, the inter-reader correlation was higher with a quantitative assessment when compared with a qualitative one, which justifies its utilisation for a more accurate evaluation of the SIJ by PET imaging.

In our study, only seven of the twenty-three patients had a radiographic sacroilitis, which is different than what has been reported in the literature. In fact, in most of the studies, the evaluation of PET imaging is conducted on a population of AS (18, 20, 21, 23), but we found that PET imaging can be positive for non-radiographic sacroiliitis. In a study by Toussirot *et al*., no uptake of ^{18}F-NaF PET was noted in SpA without structural sacroiliitis on radiography and also without inflammatory sacroiliitis on MRI (26).

We also found a significant correlation between the PET activity score and clinical activity scores (BASDAI and BASFI) but not with inflammation and structural changes, which is consistent with the results reported in the literature (25, 27).

The performance of ^{18}F-NaF PET/CT for the diagnosis of sacroiliitis has already been evaluated by Strobel *et al*. (20) in a population of fifteen patients with active AS in comparison with thirteen patients with non-traumatic mechanical low back pain for at least 3 months. In that study, they found a

sensitivity, specificity and accuracy of 80%, 77% and 79%, respectively, for the diagnosis of sacroliitis, with a mean SUV SIJ/sacrum ratio of >1.3 as a cut-off value, in comparison with radiography. Furthermore, it appeared that the sensitivity of PET imaging was better for grade 3 sacroiliitis (94%), which suggests that increased uptake might be correlated with post-inflammatory repair associated with osteoproliferation. In that study, as in ours, structural damage relative to osteoarthritic lesions such as osteophytes or intraarticular gas was not taken into consideration.

The main limitation of our study is the small number of examined patients, which requires the statistical analyses to be interpreted with caution. The quantitative approach, which had never been done before, aimed to compensate for this limitation. Another limitation is the absence of a control group to assess the sensibility and specificity of ^{18}F-NaF PET/CT for the diagnosis of sacroiliitis. To obtain our control group and for ethical reasons (irradiation), we will use PET/CT data from our center and made for other reasons than spondyloarthritis (for example for the prostate cancer extension assessment, the main current indication of this exam)

Conclusion

Abnormal uptake by the SIJ on ^{18}F-NaF PET is more frequent (87.0%) than inflammatory (43.5%) and structural sacroiliitis (65.2%) on MRI in a population of SpA patients. The comparison between ^{18}F-NaF PET/CT and MRI found only a significant correlation between PET-positive lesions and inflammation assessed quantitatively but not with structural damage assessed on binary and quantitative approaches. Further studies with a control group of patients for whom a^{18}F-NaF PET was performed in order to eliminate bone metastasis in case of prostate cancer are needed to determine the sensitivity and specificity of PET imaging.

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