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ORIGINAL RESEARCH

Sensitivity to change of structural outcomes in axial spondyloarthritis after 10 years of follow up. Data from the DESIR cohort

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ABSTRACT

Objective To evaluate the sensitivity to change in structural imaging outcomes over 10 years of follow-up in patients with axial spondyloarthritis (axSpA).

Methods Patients with axSpA from the Devenir des Spondyloarthropathies Indifférénciées Récentes cohort were included. Radiographs and MRIs of the sacroiliac joints (SIJ) and spine were obtained at baseline and at 1, 2, 5 and 10 years. The yearly rate of change of each structural outcome was analysed using generalised estimating equation models, including all patients with ≥1 score from ≥1 reader from ≥1 reading wave, using the time (years) as an explanatory variable and adjusting for reader and wave. All outcomes were standardised, and the relative standardised rate of change was calculated (ie, the standardised rate of an outcome divided by the rate of a reference outcome).

Results A total of 659 patients (46% males and mean age 33.6 years) were included. The most sensitive outcome to change in the SIJ (both MRI and radiographs) was the presence of ≥3 fatty lesions at a specific timepoint, with a relative standardised rate of change per year of 5.28 using the modified New York criteria as reference.
Similarly, the most sensitive to change (in both MRI and radiographs) outcome in the spine was the modified Stoke Ankylosing Spondylitis Spinal Score (mSASSS; relative standardised yearly change 1.76) using ≥1 syndesmophyte as reference.

Conclusion MRI structural outcomes in the SIJ (ie, fatty lesions) are more sensitive to change than radiographic outcomes. Conversely, the mSASSS remains the most sensitive method, even when compared with MRI of the spine.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Monitoring the structural damage is an essential part of the follow-up of patients with axial spondyloarthritis.
⇒ Structural changes can be assessed with both MRIs and radiographs.

WHAT THIS STUDY ADDS

⇒ MRI structural outcomes in the sacroiliac joints (SIJ) were more sensitive to change than radiographic outcomes.
⇒ Modified Stoke Ankylosing Spondylitis Spinal Score remained the most sensitive outcome for the spine.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ MRI-SIJ and spine radiographs are the most useful methods for monitoring structural outcomes.

BACKGROUND

Axial spondyloarthritis (axSpA) is a chronic inflammatory disease characterised by inflammation of the axial skeleton, leading to erosions and new bone formation in the sacroiliac joints (SIJ) and spine.[1] Conventional radiography and MRI are the two imaging techniques most frequently used by these patients. While inflammation can only be detected by MRI, structural changes can be assessed with both MRI and radiographs.[2]

Structural damage in the SIJ and spine may have an impact on function and spinal mobility,[3 4] so monitoring the structural damage is an essential part of the follow-up of these patients. In fact, structural outcomes to assess the structural progression on the spine, such as the modified Stoke Ankylosing Spondylitis Spinal Score (mSASSS), have been included in the Assessment of Spondyloarthritis international Society (ASAS) core outcome set for axSpA as a mandatory instrument for disease-modifying drug trials.[5]

However, there is little information concerning the most appropriate method for detecting long-term structural changes in patients with axSpA.[6] Recently, fatty lesions on MRI have been reported as the lesions with the highest sensitivity to change in the SIJ, while the mSASSS was the most sensitive

method for evaluating structural progression in the spine after 5 years of follow-up in the Devenir des Spondyloarthropathies Indifférénciées Récentes (DESIR) cohort.[7] However, 5 years of follow-up may prove insufficient for detecting structural changes in these patients, especially considering that this population had, at baseline, experienced symptoms for less than 3 years. Thus, the availability of 10-year data in this cohort provided the opportunity to evaluate which structural lesions are the most sensitive outcomes for assessing structural progression in patients with axSpAafter 10 years of follow-up, which reflects a real long-term follow-up.[8]

In this study, we aimed to analyse the sensitivity in change of the different structural lesions detected on MRI and radiographs of the SIJ and spine in patients with axSpA.

METHODS

Design and population

10-year data from patients from the DESIR inception cohort were used (ClinicalTrials.gov identifier: NCT91648907), that is, adult patients (≥18 years and <50 years) with inflammatory back pain according to either the Calin or Berlin criteria[9 10] for >3 months but <3 years and symptoms suggestive of SpA according to the rheumatologists' assessment (score ≥5 on a numerical rating scale of 0–10, where 0=not suggestive and 10=very suggestive of SpA). Visits were scheduled every 6 months for 2 years and annually thereafter. Patients with conditions that might interfere with the validity of informed consent and/or prevent optimal compliance (eg, alcoholism and psychiatric disorders) and a history of tumour necrosis factor (TNF)-alpha inhibitor usage were excluded. As DESIR is an inception cohort, during the 10-year follow-up, some patients ended up receiving a different diagnosis than axSpA and were therefore excluded from this study.

For this specific analysis, only patients with ≥1 radiograph and/or MRI scan available during the 10-year follow-up period were included. The dataset used for this analysis was locked in July 2022. All patients provided signed informed consent, and the study was approved by the appropriate local medical ethical committees.

Central reading

Radiographs and MRIs of the SIJ and spine were obtained at baseline and at 1, 2, 5 and 10 years. Each radiograph and MRI were independently scored in four reading waves by experienced central readers blinded to chronology, clinical data and the results of other readers. In wave 1, baseline images were evaluated by two readers per modality and one adjudicator for binary variables in case of disagreement. In wave 2, baseline, 1-year and 2-year images were scored by two readers and one adjudicator for binary variables in case of disagreement. Wave 3 included baseline, 2-year and 5-year images evaluated by three readers. Finally, in wave 4, three readers evaluated baseline, 5-year and 10-year images.

For each imaging modality, the scores from the readers were combined; for continuous outcomes (ie, SIJ radiographic grading), the mean of the available readers was calculated. For binary outcomes (ie, modified New York (mNY) criteria yes/no and positive MRI-SIJ yes/no), in cases of disagreement in waves 1 and 2, an adjudicator was included and the score of the adjudicator was used, while in waves 3 and 4, the score agreed by two out of the three readers was used. For this specific analysis, all waves were included.

Structural outcomes

Structural damage on radiographs of the SIJ was assessed according to the mNY criteria as a continuous range (0–8) and as a binary outcome (positive/negative).[11] Two additional definitions were assessed: worsening of ≥1 grade in ≥1 SIJ (yes/no) and worsening of ≥1 grade in ≥1 SIJ with a 10-year grade ≥2 in the worsened joint (yes/no).[12]

MRI-SIJ was performed on a 1–1.5 Tesla (T) scanner providing a T1-weighted turbo spin-echo sequence. For MRI-SIJ, fatty lesions, erosions and sclerosis were considered if present on ≥2 consecutive slices (maximum five lesions in six slices per each of the eight quadrants in both SIJ). Partial ankylosis and ankylosis cannot occur simultaneously in a quadrant, and ankylosis always involves two quadrants. In the absence of a formal consensus on how to measure structural lesions on the MRI-SIJ, we considered three definitions previously shown to be most discriminatory in these patients[13]: ≥5 fatty lesions and/or erosions, ≥3 erosions and ≥3 fatty lesions. Continuous variables concerning structural lesions on MRI-SIJ included the number of fatty lesions and/or erosions (range 0–80), number of erosions (range 0–40), number of fatty lesions (range 0–40) and total number of structural lesions (ie, fatty lesions, erosions and partial ankylosis) with (range 0–144) and without (range 0–104) sclerosis.

For radiographs of the spine, the presence of ≥1 syndesmophyte (yes/no) and the mSASSS (0–72) were used.

Finally, structural lesions on MRI of the spine were scored according to the Canada–Denmark method.[14 15] In the absence of a formal definition, we defined structural damage as ≥5 fatty lesions.[13] The total number of structural lesions (fatty lesions, erosions, bone spurs and ankylosis) (range 0–322) was assessed, as well as the total number of fatty lesions, erosions and bone spurs separately (range 0–92 for each of them).

Statistical analysis

The rate of change of each outcome was analysed using multilevel generalised estimating equations models with an 'exchangeable' correlation structure, including the variable 'time' in years as an explanatory variable and adjusted for the levels of 'reader' and 'wave'. Since the outcomes had different units and ranges, all variables (ie, the outcome and the explanatory variables) were standardised using the difference between the individual's

value and the population mean divided by the population SD to perform comparisons across outcomes. Standardised rates of change allowed the comparison across all outcomes, including both continuous and binary variables. Outcomes with rates closer to 1 or −1 are more sensitive to change.

Each outcome was analysed using an 'integrated multilevel analysis', including all patients with ≥1 score from ≥1 reader from ≥1 reading wave (ie, 'intention-to-follow' population). This assumption-free method has demonstrated that it does not compromise the precision of the estimated changes in imaging parameters while potentially enhancing the statistical power to detect changes with low incidence. Another significant advantage of this approach is that, unlike the completer analysis, it incorporates all individual scores (each score at each time point from each wave from each reader), thereby including all patients who have ever had their imaging assessed. This approach, referred to as the 'intention-to-follow' population, closely corresponds to the complete DESIR population, thus minimising selection bias.[16] In addition, two sensitivity analyses were conducted: one using only patients fulfilling the ASAS classification criteria for axSpA and another including patients with at least two timepoints with images.

In addition, the relative standardised rate of change (ie, the standardised yearly rate of change of an outcome divided by the corresponding rate of a reference imaging outcome) was calculated. For this calculation, a value >1 indicates greater sensitivity, and a value <1 indicates lower sensitivity compared with the reference. By anatomic site, mNY status was considered the reference for the SIJ, while the presence of ≥1 syndesmophyte was considered as the reference for the spine. In order to compare the outcomes within each modality of each anatomic site, one specific reference was considered for each combination: (1) mNY for radiographs of the SIJ, (2) ≥5 fatty lesions and/or erosions for the MRI-SIJ, (3) ≥1 syndesmophyte for radiographs of the spine and (4) ≥5 fatty lesions for the MRI of the spine.

Different transformations of time (eg, time*time interaction: quadratic term) were tested to assess which one yielded the lowest quasi-likelihood under the independence model criterion (better fit), reflecting a better fit of the data. A non-linear model was chosen if it best fits the data and if the non-linear factor (eg, quadratic term) added to the model was significant ($p<0.05$). R Studio V.4.0.4 was used for the analyses.

RESULTS

Baseline characteristics of the 'intention-to-follow' population

Out of the 708 patients in the DESIR cohort, four patients were excluded because of missing images at baseline and 45 patients because of an alternative diagnosis over the 10 years of follow-up. Despite only 294 patients having both baseline and 10-year images, a total of 659 patients were included in this analysis (ie, the 'intention-to-follow' population, represented by patients with ≥1 score from ≥1 reader from ≥1 reading wave). At baseline (table 1), 46% were male, the mean age was 33.6 (8.6) years, and the mean symptom duration was 1.5 (0.9) years. 59% were human leucocyte antigen B27 positive, and 22% had radiographic structural damage on the SIJ, according to the central readers.

Table 1 Baseline characteristics of the included ('intention-to-follow') population

	Intention-to-follow population, n=659
Male gender	304 (46%)
Age (years)	33.6 (8.6)
Body mass index, kg/m^2	24 (4.1)
Symptom duration (years)	1.5 (0.9)
Human leucocyte antigen B27 positivity	390/658 (59%)
Family history of spondyloarthritis	277/622 (45%)
Fulfilment ASAS criteria	416 (63%)
Fulfilment AMOR criteria	534/632 (84%)
Fulfilment ESSG criteria	516 (78%)
Fulfilment of either ASAS, AMOR or ESSG criteria	613/654 (94%)
Conventional synthetic DMARD ever	91/567 (16%)
Biologic DMARD ever	0 (0%)
Abnormal C reactive protein	190/638 (30%)
Bath Ankylosing Spondylitis Disease Activity Index (0–10)	4.4 (2.0)
Ankylosing Spondylitis Disease Activity Score	2.7 (0.9)
Bath Ankylosing Spondylitis Functional Index (0–10)	3 (2.3)

Data presented as mean (SD) or n (%), as appropriate.
ASAS, Assessment of Spondyloarthritis international Society; DMARD, disease-modifying antirheumatic drug; ESSG, European Spondyloarthropathy Study Group.

The baseline structural outcomes of the 'intention-to-follow' population according to the central reading wave 1 are shown in table 2. 22% had radiographic sacroiliitis and 5% had at least one syndesmophyte at baseline.

Standardised rate of change of each outcome

The standardised rate of change per year of the evaluated outcomes is shown in table 3. In general, the pelvic radiograph and MRI spine outcomes were all close to zero, meaning that there was essentially no change in these outcomes.

Interestingly, worsening of ≥1 grade in ≥1 SIJ with a 10-year grade ≥2 in the worsened joint showed the highest standardised yearly change on the SIJ-radiograph (0.11 (95%CI 0.08 to 0.13)). Overall, the variable ≥3 fatty

Table 2 Baseline outcomes of structural lesions (wave 1) of the included ('intention-to-follow') population

	Intention-to-follow population, n=659
Pelvic radiographs	
Radiographic sacroiliitis (mNY criteria) (wave 1)**	141/644 (22%)
mNY continuous grade (range 0–8)	1.5 (2.1)
MRI of the SIJ	
≥5 fatty lesions and/or erosions	44/535 (9%)
≥3 erosions	51/560 (9%)
≥3 fatty lesions	16/513 (3%)
No. of erosions (range 0–40)	0.8 (1.5)
No. of fatty lesions (range 0–40)	1.1 (2.7)
Total structural lesions (range 0–144)†	2.6 (4.8)
Patients with at least one structural lesion†	277/622 (44%)
Total structural lesions among patients with at least one structural lesion (range 0–144) †	5.7 (5.7)
Total structural lesions without sclerosis (range 0–104)	2.1 (4.5)
Spine radiographs	
≥ 1 syndesmophyte	34/625 (5%)
mSASSS score (range 0–72)	0.4 (1.8)
MRI of the spine	
≥5 fatty lesions	9/432 (2%)
Total structural lesions (range 0–322)‡	1.2 (4.0)
Patients with at least one structural lesion‡	175/607 (29%)
Total structural lesions among patients with at least one structural lesion (range 0–322)‡	7.7 (9.6)
No. of fatty lesions (range 0–92)	1.5 (4.7)
No. of corner erosions (range 0–92)	0.1 (0.4)
No. of corner bone spurs (range 0–92)	0.2 (0.8)

Data presented as mean (SD) or n (%), as appropriate.
*First central reading wave (wave 1).
†Structural lesions on the MRI of the SIJ include sclerosis, erosions, fatty lesions or partial ankylosis.
‡Structural lesions on the MRI of the spine include corner erosions, fatty lesions, corner ankylosis or corner bone spurs.
mNY, modified New York criteria; mSASSS, modified Stoke Ankylosing Spondylitis Spinal Score; SIJ, sacroiliac joints.

lesions showed the highest yearly rate of change in the SIJ (0.23 (95%CI 0.13 to 0.32)). It should be noted that this outcome exhibited a quadratic distribution, which means that it increased more in the beginning and then tended to stabilise over time. On the other hand, the mSASSS showed the highest standardised yearly change (0.14 (95%CI 0.10 to 0.18)) in the spine (considering both MRI and radiographs).

Relative standardised rate of change of each outcome

With the aim of evaluating which outcome was more sensitive to change across all imaging outcomes, we considered mNY as a binary variable as the reference (second column, table 3). We found that the most sensitive outcomes were ≥3 fatty lesions on the MRI-SIJ (relative standardised rate of change 5.429) and the number of fatty lesions at the MRI-SIJ in a continuous range (relative standardised yearly change 4.619), both reflecting a higher sensitivity than mNY. For the spine, mSASSS was revealed to be the most sensitive outcome, with a relative standardised rate of change of 3.262 in comparison with mNY as the reference.

Relative standardised rate of change of each outcome in the SIJ

For the overall SIJ outcomes, we again used mNY as a binary variable as the reference (third column, table 3), and we found that the most sensitive outcome in the SIJ was ≥3 fatty lesions (relative standardised rate of change 5.429), and the second most sensitive was the number of fatty lesions in a continuous range (relative standardised yearly change 4.619). The least sensitive outcome in the SIJ was ≥3 erosions (relative standardised rate of change 0.714).

Then, we evaluated the relative standardised rate of change per modality and per anatomic site (ie, SIJ-radiograph and MRI-SIJ) (fourth column, table 3). For radiographs, we found that worsening of ≥1 grade in ≥1 SIJ with a 10-year grade ≥2 in the worsened joint was the most sensitive outcome (relative standardised rate of

Table 3 Standardised yearly rate of change of structural outcomes on the SIJ and spine over 10 years of follow-up

	Imaging outcome	Standardised rate of change per year (95% CI)*	Relative standardised rate of change	Relative standardised rate of change per anatomic site	Relative standardised rate of change per modality and anatomic site
SIJ radiographs	mNY dichotomous	0.042 (0.030 to 0.054)	1 (reference)	1 (reference)	1 (reference)
	mNY 1-grade change	0.047 (0.006 to 0.087)	1.119	1.119	1.119
	mNY 1-grade change and value ≥2	0.109 (0.084 to 0.134)	2.595	2.595	2.595
	mNY continuous grade (range 0–8)	0.045 (0.035 to 0.054)	1.071	1.071	1.071
MRI-SIJ	≥5 fatty lesions and/or erosions	0.167 (0.081 to 0.253)†	3.976	3.976	1 (reference)
	≥3 erosions	0.030 (0.006 to 0.054)	0.714	0.714	0.180
	≥3 fatty lesions	0.228 (0.132 to 0.324)†	5.429	5.429	1.365
	No. of erosions (range 0–40)	0.039 (0.014 to 0.063)	0.929	0.929	0.234
	No. of fatty lesions (range 0–40)	0.194 (0.106 to 0.282)	4.619	4.619	1.162
	Total structural lesions (range 0–144)‡	0.099 (0.073 to 0.127)	2.357	2.357	0.593
	Total structural lesions without sclerosis (range 0–104)	0.098 (0.070 to 0.126)	2.333	2.333	0.587
Spine radiographs	≥1 syndesmophyte	0.078 (0.057 to 0.098)	1.857	1 (reference)	1 (reference)
	mSASSS score (range 0–72)	0.137 (0.098 to 0.175)	3.262	1.756	1.756
MRI spine	≥5 fatty lesions	−0.068 (-0.093 to -0.044)†	1.619	0.872	1 (reference)
	Total structural lesions (range 0–322)§	0.060 (0.039 to 0.081)†	1.429	0.769	0.882
	No. of fatty lesions (range 0–92)	0.064 (0.041 to 0.087)†	1.524	0.821	0.941
	No. of corner erosions (range 0–92)	0.023 (0.004 to 0.043)†	0.548	0.295	0.338
	No. of corner bone spurs (range 0–92)	0.057 (0.029 to 0.085)	1.357	0.731	0.838

Rates of change closer to 1 or −1 are more sensitive to change.
*All independent variables (time, reader and wave) and the outcome were standardised.
†Quadratic distribution.
‡Structural lesions on the MRI of the SIJ include sclerosis, erosions, fatty lesions or partial ankylosis.
§Structural lesions on the MRI of the spine include corner erosions, fatty lesions, corner ankylosis or corner bone spurs.
mNY, modified New York criteria; SIJ, sacroiliac joints.

change 2.595 in comparison with mNY binary variable), while on the MRI-SIJ, ≥3 fatty lesions was the most sensitive outcome (relative standardised yearly change 1.365 in comparison with ≥5 fatty lesions and/or erosions).

Relative standardised rate of change of each outcome in the spine

In the spine (third column, table 3), the most sensitive outcome for the spine was the mSASSS (relative standardised rate of change 1.756 in comparison with the reference, ≥1 syndesmophyte), while the second was ≥5 fatty lesions (relative standardised yearly change 0. 872). The least sensitive outcome in the spine was the number of corner erosions (range 0–92) (relative standardised rate of change 0.295).

Finally, stratifying the results per modality (fourth column, table 3), in the radiographs of the spine, we found that the relative standardised yearly change of the mSASSS was 1.756. On the other hand, the number of fatty lesions was the most sensitive outcome in the MRI of the spine in comparison with the reference (≥5 fatty lesions; relative standardised rate of change 0.941).

Sensitivity analyses

The two sensitivity analyses conducted in patients fulfilling the ASAS classification criteria for axSpA and in patients with at least two timepoints showed similar results, confirming that the most sensitive outcome in the SIJ was ≥3 fatty lesions (online supplemental tables 1 and 2). In patients fulfilling the ASAS criteria, the relative standardised rate of change of ≥3 fatty lesions in the SIJ was 5.615, using mNY as a binary variable as the reference. In patients with at least two available observations, this relative standardised rate of change was 5.439.

Similarly, these two sensitivity analyses confirmed that using ≥1 syndesmophyte as the reference, the most sensitive outcome in the spine was the mSASSS (online supplemental tables 1 and 2), with a relative standardised rate of change of 1.487 and 1.760 in the patients fulfilling the ASAS classification criteria and in patients with at least two available timepoints, respectively. These results validate and support the credibility of the main findings.

DISCUSSION

This study showed that MRI structural outcomes in the SIJ, specifically fatty lesions, were more sensitive to change than radiographic outcomes after 10 years of follow-up in patients with axSpA with <3 years of symptoms. On the other hand, mSASSS remained the most sensitive outcome for the spine, even when compared with MRI outcomes. These results are in line with those found in

this same cohort after 5 years of follow-up, suggesting that MRI of the SIJ and radiographs of the spine are the most useful methods for monitoring structural outcomes in the long term.

Although pelvic radiography is the most widely used method in clinical practice, we demonstrate that the detection of a change in the sacroiliacs is infrequent, even over a long period such as 10 years. In fact, recent data in this DESIR cohort evaluating the progression from non-radiographic-axSpA to radiographic-axSpA (ie, from mNY negative to mNY positive) showed that the probability of progression was 8.7% after 10 years in the overall population and 4.5% when adjusted for treatment with TNF inhibitors,[17] confirming that the mNY criteria are not sensitive enough and therefore not useful for monitoring structural damage in these patients. Conversely, our results showed that worsening of ≥1 grade in ≥1 SIJ with a 10-year grade ≥2 in the worsened joint was the most sensitive outcome in the pelvic radiographs, but less sensitive than MRI-SIJ. In fact, we found that the most sensitive method for evaluating structural progression in the SIJ was fatty lesions on MRI, while erosions were less sensitive. This can be explained for two main reasons. First, we analysed patients in the early stage of the disease, in which the prevalence and incidence of erosions are low.[18] Second, fatty lesions occur more often over time than erosions, leading to a higher sensitivity to change.[19] Hence, our data support the use of MRI as an alternative to radiographs in detecting changes in structural damage, particularly fatty lesions, in the SIJ.

These results may have implications not only in clinical practice but also in clinical trials. It has been demonstrated that the presence of structural lesions in the SIJ is associated with higher radiographic progression in the spine, as evaluated by the mSASSS.[20] Thus, monitoring structural lesions in the SIJ could potentially be useful for predicting syndesmophytes in the spine, though this requires further investigation. However, this does not mean that MRI-SIJ should be measured in all trials, but it could be considered in studies aimed at evaluating the effect of treatments on structural lesions. The reduction or slowing of structural progression is considered a relevant aim in therapeutic trials, and many observational (and recently randomised) studies have tried to elucidate whether the inhibition of tumour necrosis factor or interleukin 17A (IL-17A) can reduce structural progression. Hence, the selection of the structural outcome with the highest likelihood of detecting changes is crucial in the design of these studies. Our results confirm that the mSASSS represents the best method to evaluate structural progression in the spine when considering radiographs and MRI and, in fact, the mSASSS was the only instrument evaluating the structural damage endorsed by the ASAS members to be included in the ASAS core outcome set.[5] However, it should be noted that previous studies have demonstrated that low-dose CT detects more progression in the form of new and growing syndesmophytes in these patients compared with conventional radiography, emerging as a promising alternative for assessing spinal structural damage.[21]

Interestingly, we found that MRI of the spine was not as useful as radiographs in detecting changes in structural damage. Previous data in other cohorts reported poor reliability for detecting bone erosions and new bone formation in the MRI of the spine, which was explained by the low prevalence of these lesions in the investigated cohort.[22] This may also be the case in our study since the DESIR cohort includes patients with axSpA with less than 3 years of symptoms. However, despite the potentially low number of erosions and syndesmophytes, we found a higher sensitivity to change in the mSASSS in comparison with the MRI outcomes, which shows that radiographs are better than MRI for the detection of structural lesions in the spine.

One strength of this study is the statistical technique applied (ie, integrated multilevel analysis), which has been previously shown to be robust for the evaluation of change over long follow-up periods, especially with outcomes that are expected to occur infrequently over time.[16] One advantage of this methodology is that agreement between two or three readers is not needed, but the individual score of each reader is considered, as well as the variability across readers. In addition, this technique allows us to include a larger number of patients compared with a complete analysis since all patients with at least one observation can be included. This method has proven to preserve the precision of estimated changes in imaging parameters and may increase the statistical power to detect infrequent changes. One limitation of this study is that we did not explore the change in the size of the structural lesions, which could also be considered a progression of the structural damage. However, we focused on changes in the number of structural lesions, which are more clinically relevant, especially since evaluating lesion size on the spine could be challenging in clinical practice. These challenges are current in the field of axSpA, in which the community of experts is still seeking a better understanding and agreement on how to optimally measure the progression of structural lesions. Another limitation is that small lesions may potentially have been undetected since MRIs were performed with 1–1.5 T scanners.

In summary, these results suggest that MRI is preferable for monitoring structural damage in the SIJ, while radiographs are preferable for monitoring the spine. These data may be useful for the selection of imaging scoring methods in observational studies and clinical trials conducted in patients with axSpA.

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Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants. This study was conducted according to the Good Clinical Practice guidelines and was approved by the local ethical committee (EUDRACT#2007 A00608-45, Ethical committee file#2457, dated 17 September 2007). Participants gave informed consent to participate in the study before taking part.

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