SUPPLEMENTARY MATERIAL

S1. Research questions (RQ)

Making a diagnosis of spondyloarthritis

RQ1- What is the diagnostic value of individual imaging modalities above clinical examination/criteria for axial SpA?

RQ2- What is the diagnostic value of individual imaging modalities above clinical examination/criteria for peripheral SpA (including peripheral psoriatic arthritis)?

Monitoring disease activity and structural damage in spondyloarthritis

RQ3- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor disease activity in axial SpA?

RQ4- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor structural changes in axial SpA?

RQ5- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor disease activity in peripheral SpA (including peripheral psoriatic arthritis)?

RQ6- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor structural changes in peripheral SpA (including peripheral psoriatic arthritis)?

Predicting outcome (severity) and treatment response

RQ7- What is the ability, and added value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict outcome (severity) in axial SpA?

RQ8- What is the ability and value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict treatment response in axial SpA?

RQ9- What is the ability, and added value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict outcome (severity) in peripheral SpA?

RQ10- What is the diagnostic value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict treatment response in peripheral SpA?

Making a diagnosis of spinal fracture or osteoporosis in spondyloarthritis
RQ11- What is the diagnostic value of individual imaging modalities above other imaging modalities for spinal fractures in SpA?

RQ12- What is the ability of individual imaging modalities to diagnose and monitor osteoporosis in SpA?

S2. Details of search strategy performed using MEDLINE via Pubmed (1948 to January 2013) and EMBASE via Ovid (1980 to January 2013).

RQ1-10

Search strategy, MEDLINE via Pubmed

1. "spondylarthropathies"[MeSH Terms]
2. spondylart*[Text Word]
3. (Reactiv*[TI] AND Arthriti*[TI])
4. (Psoria*[TI] AND Arthriti*[TI])
5. (ankyl*[TI] AND Spondyl*[TI])
7. spondylo*[TIAB]
8. (((inflam*[TIAB] AND (back*[TIAB] OR spin*[TIAB]) AND pain [TIAB] )))
9. or/1-8
10. "Tomography"[Mesh]
11. "Magnetic Resonance Imaging"[Mesh]
12. "Ultrasoundography"[Mesh]
15. "Positron-Emission Tomography"[Mesh]
17. ("magnetic"[All Fields] AND "resonance"[All Fields] AND "imaging"[All Fields])
18. "mri"[All Fields]
19. ultrasono*[TIAB]
20. echograph*[TIAB]
21. "CT scan*"[TIAB]
22. tomograph*[TIAB]
23. scintigraph*[TIAB]
24. (PET[Title/Abstract]) AND tomog*[Title/Abstract])
25. (SPECT[Title/Abstract]) AND photon[Title/Abstract])
26. or/10-25
27. 9 and 26
28. (animals[mh] NOT human[mh])
29. 27 not 28
30. ("case report*"[TI]) OR (case reports[Publication Type]))
31. 29 not 30
32. english[Language]
33. 31 and 32
Search strategy, EMBASE via Ovid

1. (magnetic and resonance and imaging).mp.
2. magnetic resonance imaging.mp.
3. mri.mp.
4. Ultrasonography.mp. or exp echography/
5. magnetic resonance imaging.mp. or exp nuclear magnetic resonance imaging/
6. "ultrasono".ti,ab.
7. Tomography, X-Ray Computed.mp. or exp computer assisted tomography/
8. "CT scan".ti,ab.
10. "tomograph".ti,ab.
11. "scintigraph".ti,ab.
12. Positron Emission Tomography.mp. or exp positron emission tomography/
13. (PET and tomog*).ti,ab.
14. Tomography, Emission-Computed, Single-Photon.mp. or exp single photon emission computer tomography/
15. (SPECT and photon).ti,ab.
16. or/1-15
17. exp ankylosing spondylitis/
18. exp psoriatic arthritis/
19. exp reactive arthritis/
20. exp spondyloarthropathy/
21. (inflam* and (peripher* or tendon* or tendinop* or limb*) and pain).ti,ab.
22. "spondylo".ti,ab.
23. (inflam* and (back or spin*) and pain).ti,ab.
24. or/17-23
25. 16 and 24
26. limit 25 to (conference abstract or conference paper or "conference review" or letter or conference proceeding)
27. 25 not 26
28. limit 27 to (animals or animal studies)
29. limit 28 to human
30. 28 not 29
31. 27 not 30
32. "case report".m_titl.
33. case study.m_titl.
34. case report/
35. or/28-30
36. 31 not 35
37. limit 36 to english language
RQ11

Search strategy, MEDLINE via Pubmed

1. "spondylarthropathies"[MeSH Terms]
2. spondylart*[Text Word]
3. (Reactiv*[TI] AND Arthriti*[TI])
4. (Psoria*[TI] AND Arthriti*[TI])
5. (anky*[TI] AND Spondyl*[TI])
6. (((inflam*[TIAB] AND (peripher*[TIAB] OR tendon*[TIAB] or tendinop*[TIAB] OR
   limb*[TIAB])) AND pain [TIAB])))
7. spondylo*[TIAB]
8. (((inflam*[TIAB] AND (back*[TIAB] OR spin*[TIAB])) AND pain [TIAB])))
9. or/1-8
10. "Tomography"[Mesh]
11. "Magnetic Resonance Imaging"[Mesh]
12. "Ultrasoundography"[Mesh]
15. "Positron-Emission Tomography"[Mesh]
17. ("magnetic"[All Fields] AND "resonance"[All Fields] AND "imaging"[All Fields])
18. "mri"[All Fields]
19. ultrasono*[TIAB]
20. echograph*[TIAB]
21. "CT scan*[TIAB]
22. tomograph*[TIAB]
23. scintigraph*[TIAB]
24. (PET[Title/Abstract]) AND tomog*[Title/Abstract])
25. (SPECT[Title/Abstract]) AND photon[Title/Abstract])
26. x*ray*
27. "Radiography"[Mesh]
28. or/10-27
29. "Fractures, Bone"[Mesh]
30. "Fractures, Spontaneous"[Mesh]
31. "Osteoporotic Fractures"[Mesh]
32. "Spinal Fractures"[Mesh]
33. fractur*
34. or/29-33
35. 9 and 28 and 34
36. (animals[mh] NOT human[mh])
37. 35 not 36
38. (("case report*"[TI]) OR (case reports[Publication Type]))
39. 37 not 38
40. english[Language]
41. 39 and 40
Search strategy, EMBASE via Ovid

1. (magnetic and resonance and imaging).mp.
2. magnetic resonance imaging.mp.
3. mri.mp.
4. Ultrasonography.mp. or exp echography/
5. magnetic resonance imaging.mp. or exp nuclear magnetic resonance imaging/
6. "ultrasono**".ti,ab.
7. Tomography, X-Ray Computed.mp. or exp computer assisted tomography/
8. "CT scan**".ti,ab.
9. "echograph**".ti,ab.
10. "tomograph**".ti,ab.
11. "scintigraph**".ti,ab.
12. Positron Emission Tomography.mp. or exp positron emission tomography/
13. (PET and tomog*).ti,ab.
14. Tomography, Emission-Computed, Single-Photon.mp. or exp single photon emission computer tomography/
15. (SPECT and photon).ti,ab.
16. exp radiography/
17. x*ray*.mp.
18. exp X ray/
19. or/1-18
20. exp fracture/
21. fractur*.mp.
22. or/20-21
23. exp ankylosing spondylitis/
24. exp psoriatic arthritis/
25. exp reactive arthritis/
26. exp spondyloarthropathy/
27. (inflam* and (peripher* or tendon* or tendinop* or limb*) and pain).ti,ab.
28. "spondylo*".ti,ab.
29. (inflam* and (back or spin*) and pain).ti,ab.
30. or/23-29
31. 19 and 22 and 30
32. limit 31 to (conference abstract or conference paper or "conference review" or letter or conference proceeding)
33. 31 not 32
34. limit 33 to (animals or animal studies)
35. limit 34 to human
36. 34 not 35
37. 33 not 36
38. "case report**".m_titl.
39. case study.m_titl.
40. case report/
41. or/38-40
42. 37 not 41
43. limit 42 to english language
RQ12

Search strategy, MEDLINE via Pubmed

1. "spondylarthropathies"[MeSH Terms]
2. spondylart*[Text Word]
3. (Reactiv*[TI] AND Arthriti*[TI])
4. (Psoria*[TI] AND Arthriti*[TI])
5. (ankyl*[TI] AND Spondyl*[TI])
7. spondylo*[TIAB]
8. (((inflam*[TIAB] AND (back[TIAB] OR spin*[TIAB]) AND pain [TIAB])))
9. or/1-8
10. "Tomography"[Mesh]
11. "Magnetic Resonance Imaging"[Mesh]
12. "Ultrasonography"[Mesh]
15. "Positron-Emission Tomography"[Mesh]
17. (*magnetic*[All Fields] AND "resonance"[All Fields] AND "imaging"[All Fields])
18. "mri"[All Fields]
19. ultrasono*[TIAB]
20. echograph*[TIAB]
21. "CT scan*[TIAB]
22. tomograph*[TIAB]
23. scintigraph*[TIAB]
24. (PET[Title/Abstract]) AND tomog*[Title/Abstract])
25. (SPECT[Title/Abstract]) AND photon[Title/Abstract])
26. x*ray*
27. "Radiography"[Mesh]
28. "Absorptiometry, Photon"[Mesh]
29. DEXA
30. (bone*[TIAB]) AND densit*[TIAB]
31. "Bone Density"[Mesh]
32. or/10-31
33. osteoporos*
34. "Osteoporosis"[Mesh]
35. "Bone Density"[Mesh]
36. ((bone*[TIAB]) AND (loss*[TIAB] OR densit*[TIAB] OR mass*[TIAB]))
37. or/33-36
38. 9 and 32 and 37
39. (animals[mh] NOT human[mh])
40. 38 not 39
41. (("case report"*[TI]) OR (case reports[Publication Type]))
42. 40 not 41
43. english[Language]
44. 42 and 43
Search strategy, EMBASE via Ovid

1. (magnetic and resonance and imaging).mp.
2. magnetic resonance imaging.mp.
3. mri.mp.
4. Ultrasonography.mp. or exp echography/
5. magnetic resonance imaging.mp. or exp nuclear magnetic resonance imaging/
6. "ultrasono".ti,ab.
7. Tomography, X-Ray Computed.mp. or exp computer assisted tomography/
8. "CT scan".ti,ab.
10. "tomograph".ti,ab.
11. "scintigraph".ti,ab.
12. Positron Emission Tomography.mp. or exp positron emission tomography/
13. (PET and tomog*).ti,ab.
14. Tomography, Emission-Computed, Single-Photon.mp. or exp single photon emission computer tomography/
15. (SPECT and photon).ti,ab.
16. exp radiography/
17. x*ray*.mp.
18. exp X ray/
19. DEXA.mp. or exp dual energy X ray absorptiometry/
20. exp absorptiometry/ or exp photon absorptiometry/
21. (bone* and (loss* or densit* or mass*)).ti,ab.
22. Bone Density.mp. or exp bone density/
23. or/1-22
24. (bone* and (loss* or densit* or mass*)).ti,ab.
25. Bone Density.mp. or exp bone density/
26. exp osteoporosis/ or Osteoporosis.mp.
27. osteoporo*.mp
28. or/24-27
29. exp ankylosing spondylitis/
30. exp psoriatic arthritis/
31. exp reactive arthritis/
32. exp spondyloarthropathy/
33. (inflam* and (peripher* or tendon* or tendinop* or limb*) and pain).ti,ab.
34. "spondylo*".ti,ab.
35. (inflam* and (back or spin*) and pain).ti,ab.
36. or/29-35
37. 23 and 28 and 36
38. limit 37 to (conference abstract or conference paper or "conference review" or letter or conference proceeding)
39. 37 not 38
40. limit 39 to (animals or animal studies)
41. limit 40 to human
42. 40 not 41
43. 39 not 42
44. "case report".m_titl.
45. case study.m_titl.
46. case report/
47. or/44-46
48. 43 not 47
49. limit 48 to english language
S3. Flowcharts showing the three separate literature searches of 7550 articles, from which 298 articles were selected for detailed review; 157 articles were included in the final analysis.
### S4. Number of included articles per research question

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Number of included articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1- What is the diagnostic value of individual imaging modalities above clinical examination/criteria for axial SpA?</td>
<td>25</td>
</tr>
<tr>
<td>RQ2- What is the diagnostic value of individual imaging modalities above clinical examination/criteria for peripheral SpA (including peripheral psoriatic arthritis)?</td>
<td>9</td>
</tr>
<tr>
<td>RQ3- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor disease activity in axial SpA?</td>
<td>34</td>
</tr>
<tr>
<td>RQ4- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor structural changes in axial SpA?</td>
<td>23</td>
</tr>
<tr>
<td>RQ5- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor disease activity in peripheral SpA (including peripheral psoriatic arthritis)?</td>
<td>15</td>
</tr>
<tr>
<td>RQ6- What is the ability, and added value above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) of individual imaging modalities to monitor structural changes in peripheral SpA (including peripheral psoriatic arthritis)?</td>
<td>8</td>
</tr>
<tr>
<td>RQ7- What is the ability, and added value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict outcome (severity) in axial SpA?</td>
<td>17</td>
</tr>
<tr>
<td>RQ8- What is the ability and value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict treatment response in axial SpA?</td>
<td>3</td>
</tr>
<tr>
<td>RQ9 - What is the ability, and added value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict outcome (severity) in peripheral SpA?</td>
<td>3</td>
</tr>
<tr>
<td>RQ10- What is the diagnostic value of individual imaging modalities above other measures (e.g. clinical examination, PROs, CRP, other imaging modalities) to predict treatment response in peripheral SpA?</td>
<td>0</td>
</tr>
<tr>
<td>RQ11 - What is the diagnostic value of individual imaging modalities above other imaging modalities for spinal fractures in SpA?</td>
<td>0</td>
</tr>
<tr>
<td>RQ12 - What is the ability of individual imaging modalities to diagnose and monitor osteoporosis in SpA?</td>
<td>42</td>
</tr>
</tbody>
</table>
S5. Reference list of included articles per recommendation

Recommendation 1: Diagnosing axial SpA
A. In general, conventional radiography of the SI joints is recommended as the first imaging method to diagnose sacroiliitis as part of axial SpA. In certain cases, such as young patients and those with short symptom duration, MRI of the SI joints is an alternative first imaging method.
B. If the diagnosis of axial SpA cannot be established based on clinical features and conventional radiography, and axial SpA is still suspected, MRI of the SI joints is recommended. On MRI, both active inflammatory lesions (primarily bone marrow edema) and structural lesions (such as bone erosion, new bone formation, sclerosis and fat infiltration) should be considered. MRI of the spine is not generally recommended to diagnose axial SpA.
C. Imaging modalities other than conventional radiography and MRI are not generally recommended in the diagnosis of axial SpA*. CT may provide additional information on structural damage if conventional radiography is negative and MRI cannot be performed. Scintigraphy and US are not recommended for diagnosis of sacroiliitis as part of axial SpA.


**Recommendation 2: Diagnosing peripheral SpA**

When peripheral SpA is suspected, US or MRI may be used to detect peripheral enthesitis, which may support the diagnosis of SpA. Furthermore, US or MRI might be used to detect peripheral arthropathy, tenosynovitis and bursitis.


**Recommendation 3: Monitoring disease activity in axial SpA**

MRI of the SI-joints and/or the spine may be used to assess and monitor disease activity in axial SpA, providing additional information on top of clinical and biochemical assessments. The decision on when to repeat MRI depends on the clinical circumstances. In general, STIR sequences are sufficient to detect inflammation and the use of contrast medium is not needed.


Recommendation 4. Monitoring structural changes in axial SpA

Conventional radiography of the SI joints and/or spine may be used for long-term monitoring of structural damage, particularly new bone formation, in axial SpA. If performed, it should not be repeated more frequently than every 2nd year. MRI may provide additional information.


**Recommendation 5. Monitoring disease activity in peripheral SpA**

US and MRI may be used to monitor disease activity (particularly synovitis and enthesitis) in peripheral SpA, providing additional information on top of clinical and biochemical assessments. The decision on when to repeat US/MRI depends on the clinical circumstances. US with high-sensitivity colour or power Doppler is sufficient to detect inflammation and the use of US contrast medium is not needed.


**Recommendation 6. Monitoring structural changes in peripheral SpA**

*In peripheral SpA, if the clinical scenario requires monitoring of structural damage, then conventional radiography is recommended. MRI and/or US might provide additional information.*


**Recommendation 7. Predicting outcome/severity in axial SpA**

In patients with ankylosing spondylitis* (not non-radiographic axial SpA), initial conventional radiography of the lumbar and cervical spine is recommended to detect syndesmophytes, which are predictive of development of new syndesmophytes. MRI (vertebral corner inflammatory or fatty lesions) may also be used to predict development of new radiographic syndesmophytes.

*i.e. radiographic axial spondyloarthritis*


**Recommendation 8. Predicting treatment effect in axial SpA**

**Extensive MRI inflammatory activity (bone marrow edema), particularly in the spine in ankylosing spondylitis patients, might be used as a predictor of good clinical response to anti-TNF treatment in axial SpA. Thus, MRI might aid in the decision of initiating anti-TNF therapy, in addition to clinical examination and CRP.**


**Recommendation 9. Spinal fracture**

When spinal fracture in axial SpA is suspected, conventional radiography is the recommended initial imaging method. If conventional radiography is negative, CT should be performed. MRI is an additional imaging method to CT, which can also provide information on soft tissue lesions.

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**Recommendation 10. Osteoporosis**

In axial SpA patients without syndesmophytes in the lumbar spine on conventional radiography, osteoporosis should be assessed by hip DXA and AP-spine DXA. In patients with syndesmophytes in the lumbar spine on conventional radiography, osteoporosis should be assessed by hip DXA, supplemented by either spine DXA in lateral projection or possibly QCT of the spine.


S6. Quality assessment of included studies for individual recommendations (R) with QUADAS-2

S6.1

R1

Risk of bias

Applicability concerns
R3

Risk of bias

Applicability concerns

PATIENT SELECTION

INDEX TEST

REFERENCE STANDARD

FLOW AND TIMING

0% 20% 40% 60% 80% 100%

low unclear high

27 2 5
32 2
30 4

595.2x842.0
S6.5

R5

Risk of bias

Applicability concerns

FLOW AND TIMING

INDEX TEST

REFERENCE STANDARD

PATIENT SELECTION

low unclear high

0% 20% 40% 60% 80% 100%
Risk of bias

- Patient Selection: Low (4), Unclear (1), High (3)
- Index Text: Low (6), High (2)
- Reference Standard: Low (6), High (2)
- Flow and Timing: Low (7), High (1)

Applicability concerns:

- Patient Selection: Low (7), High (1)
- Index Test: Low (6), High (2)
- Reference Standard: Low (6), High (2)

Color codes:
- Low
- Unclear
- High