

**Supplemental Figure 1: Out of the sample of patients from the SERA cohort who had AMPA measured (n=396), 233 patients with RA had suitable radiographs after scoring by the modified Sharp-van der Heijde method.**

	All RA patients	RA patients with radiographs	P value All RA patients vs RA patients with radiographs
	n=362	n=233	
<b>Demographics</b>			
Female, no. (%)	244 (67.4)	153 (65.7)	0.67 <sup>s</sup>
Age, mean ± SD years	58.2 ± 13.4	58.1 ± 13.3	0.88
Never Smoked, no. (%)	134 (37.0)	85 (36.5)	0.90 <sup>s</sup>
<b>Baseline Characteristics</b>			
Disease duration, mean ± SD months	14.4 ± 31.1	13.2 ± 24.9	0.97
Swollen joints (0–28), mean ± SD years	7.1 ± 5.1	6.8 ± 5.0	0.42
Tender joints (0–28), mean ± SD years	9.4 ± 7.0	10.2 ± 7.2	0.22
ESR, mean ± SD mm/hour (complete data)	32.3 ± 25.0 (303)	31.6 ± 23.8 (198)	0.88
CRP, mean ± SD mg/liter (complete data)	24.8 ± 32.6 (331)	24.2 ± 33.8 (204)	0.66
HAQ DI score (0–3), mean ± SD (complete data)	1.2 ± 0.8 (361)	1.2 ± 0.8 (232)	0.51
HAD score (0–21), mean ± SD (complete data)	12.1 ± 7.8 (355)	12.3 ± 7.7 (230)	0.82
EQ5D index value, mean ± SD (complete data)	0.48 ± 0.32 (361)	0.49 ± 0.33 (232)	0.84
DASVAS (0–100mm) mean ± SD	50.4 ± 26.1	48.9 ± 25.9	0.44
IgM RF high positive, no. (%)	141 (39.0)	86 (36.9)	
IgM RF low	61 (16.9)	42 (18.0)	

positive, no. (%)			
IgM RF negative, no. (%)	160 (44.2)	105 (45.1)	0.86 <sup>§</sup>
CCP high positive, no. (%)	247 (68.2)	167 (71.7)	
CCP low positive, no. (%)	37 (10.2)	18 (7.7)	
CCP negative, no. (%)	78 (21.5)	48 (20.6)	0.53 <sup>§</sup>
<b>Baseline Disease Activity</b>			
DAS28-ESR (0–9.4), mean ± SD (complete data)	5.1 ± 1.3 (303)	5.1 ± 1.4 (198)	0.87
DAS28-CRP (0–9.4), mean ± SD (complete data)	4.7 ± 1.6 (331)	4.7 ± 1.6 (204)	0.98
<b>Change in disease activity over one year</b>			
DAS28ESR delta mean ± SD (complete data)	-1.6 ± 1.6 (266)	-1.6 ± 1.5 (181)	0.75
DAS28CRP delta mean ± SD (complete data)	-2.2 ± 1.9 (241)	-2.2 ± 1.8 (152)	0.81
<b>EULAR response over one year using DAS28ESR</b>			
Complete Data	266	181	
Good (percentage within group)	104 (39.1)	69 (38.1)	
Moderate (percentage within group)	83 (31.2)	58 (32.0)	
No Response (percentage within group)	79 (29.7)	54 (29.8)	0.97 <sup>§</sup>

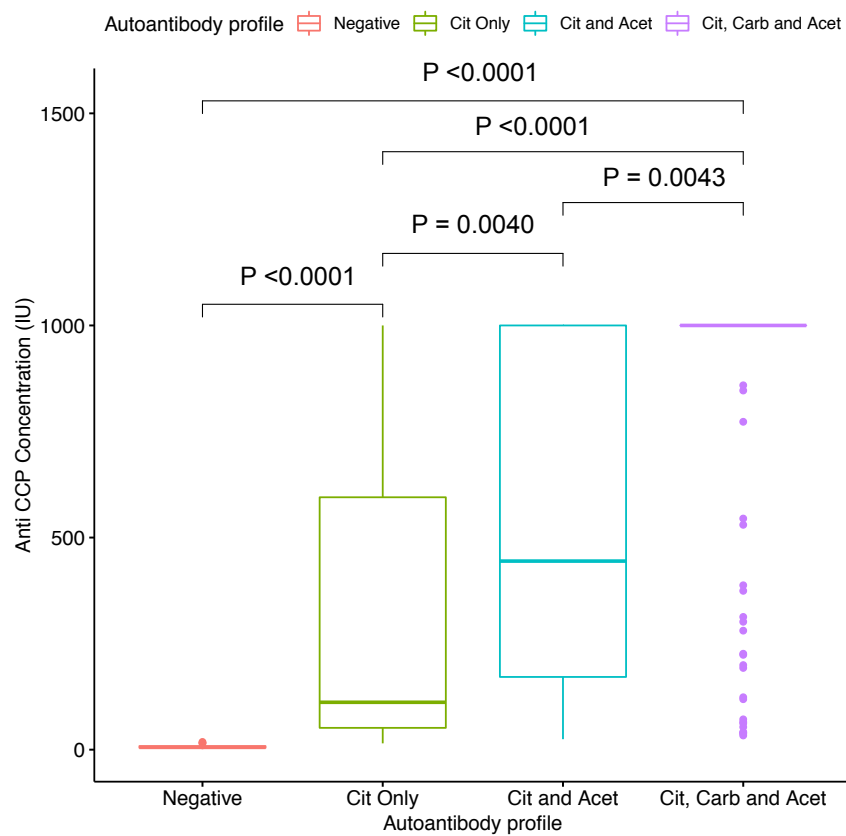
**Supplemental Table 1: Baseline Demographics for all patients with RA who had antibodies to PTM measured (n=362) and those patients with RA and radiographs suitable for analysis (n=233). Mann-Whitney-Wilcoxon U test was calculated for each row and p value between All RA patients and RA patients with radiographs is shown in the right hand column. § denotes Egon Pearson N-1 corrected Chi-Squared test for proportions. Significant values of P <0.05 are denoted in bold.**

Comparison	Estimated mean difference	Asymptotic lower 95% CI	Asymptotic upper 95% CI
<b>Difference in Total SvH change between baseline and 12 months</b>			
<b>Cit, Carb and Acet: Female v Male</b>	0.3	-1.07	1.69
<b>Cit: Female v Male</b>	0.0	-0.46	0.51
<b>Negative: Female v Male</b>	0.1	-0.58	0.70
<b>Difference in Erosion Score change between baseline and 12 months</b>			
<b>Cit, Carb and Acet: Female v Male</b>	0.5	-0.58	1.66
<b>Cit: Female v Male</b>	0.1	-0.24	0.35
<b>Negative: Female v Male</b>	0.1	-0.37	0.51
<b>Difference in Joint Space Narrowing Score change between baseline and 12 months</b>			
<b>Cit, Carb and Acet: Female v Male</b>	-0.3	-1.21	0.67
<b>Cit: Female v Male</b>	-0.1	-0.57	0.32
<b>Negative: Female v Male</b>	-0.1	-0.49	0.29

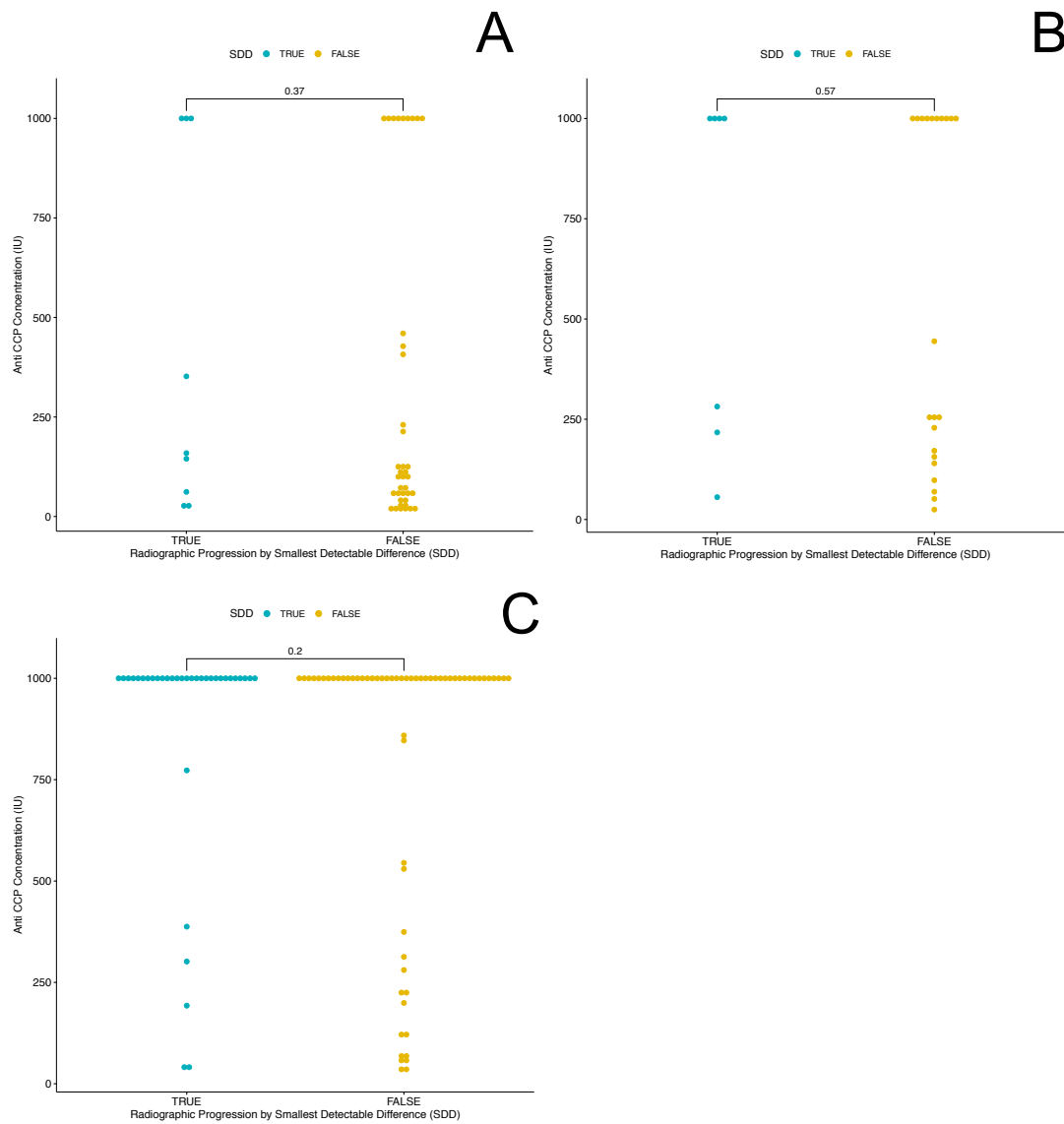
**Supplemental Table 2** Estimated mean differences in radiographic progression scores for Female and Male patients summarised by triple positive patients (Cit, Carb and Acet), single positive patients (Cit Only) and autoantibody negative.

	<b>Negative</b>	<b>Cit Only</b>	<b>Cit and Acet</b>	<b>Cit, Carb and Acet</b>	<b>P value Cit, Carb and Acet vs Cit only</b>
	n=47	n=48	n=29	n=97	
Haemoglobin, mean $\pm$ SD g/dl (complete data)	12.9 $\pm$ 1.4 (46)	13.4 $\pm$ 1.1 (46)	12.7 $\pm$ 1.8 (29)	13.5 $\pm$ 1.4 (94)	0.59
Total white cell count, mean $\pm$ SD $1 \times 10^6$ /dl (complete data)	8.4 $\pm$ 2.3 (46)	8.7 $\pm$ 2.4 (46)	8.5 $\pm$ 2.8 (29)	8.5 $\pm$ 2.2 (95)	0.72
Neutrophil count, mean $\pm$ SD $1 \times 10^6$ /dl (complete data)	5.7 $\pm$ 2.0 (46)	5.7 $\pm$ 1.6 (47)	5.8 $\pm$ 2.3 (29)	5.6 $\pm$ 1.9 (94)	0.66
Lymphocyte count, mean $\pm$ SD $1 \times 10^6$ /dl (complete data)	1.8 $\pm$ 0.7 (46)	2.0 $\pm$ 1.0 (47)	1.8 $\pm$ 0.6 (29)	1.9 $\pm$ 0.6 (94)	0.68
Monocyte count, mean $\pm$ SD $1 \times 10^6$ /dl (complete data)	0.6 $\pm$ 0.2 (46)	0.6 $\pm$ 0.2 (47)	0.6 $\pm$ 0.3 (29)	0.6 $\pm$ 0.2 (94)	0.64
Eosinophil count, mean $\pm$ SD $1 \times 10^6$ /dl (complete data)	0.2 $\pm$ 0.1 (46)	0.2 $\pm$ 0.2 (47)	0.2 $\pm$ 0.1 (29)	0.2 $\pm$ 0.2 (94)	0.33
Platelet count, mean $\pm$ SD $1 \times 10^6$ /dl (complete data)	363 $\pm$ 122 (46)	314 $\pm$ 64 (47)	375 $\pm$ 123 (29)	331 $\pm$ 107 (94)	0.64
Urea, mean $\pm$ SD (complete data)	6.2 $\pm$ 2.3 (46)	5.5 $\pm$ 1.8 (46)	7.8 $\pm$ 10.2 (28)	5.5 $\pm$ 1.7 (92)	0.83
Creatinine, mean $\pm$ SD (complete data)	68.8 $\pm$ 13.9 (46)	64.8 $\pm$ 13.5 (47)	65.4 $\pm$ 17.7 (28)	64.4 $\pm$ 13.4 (93)	0.95
Total cholesterol, mean $\pm$ SD (complete data)	5.0 $\pm$ 0.8 (27)	5.5 $\pm$ 0.9 (32)	4.7 $\pm$ 0.8 (16)	5.2 $\pm$ 1.3 (60)	0.11
HDL cholesterol, mean $\pm$ SD (complete data)	1.3 $\pm$ 0.4 (25)	1.4 $\pm$ 0.7 (30)	1.7 $\pm$ 0.8 (15)	1.3 $\pm$ 0.9 (53)	0.15

**Supplemental Table 3: Baseline laboratory tests in patients with RA and radiographs according to anti-PTM antibody status. Mann-Whitney-Wilcoxon U test was calculated for each row and p value between Cit only and Cit, Carb and Acet group is shown in the right hand column.**



**Supplemental Figure 2: In 233 patients with RA and radiographs available for analysis, anti CCP antibody concentration is increased in samples from patients with Cit, Carb and Acet antibodies (n=97) compared to Cit Only (n=48) (1000 IU vs 112 IU, fdr adjusted p value <0.0001). There are also significant differences in anti CCP antibody concentration between the Cit, Carb and Acet group (n=97) and the Cit and Acet group (n=29) ( 1000 IU vs 445 IU, fdr adjusted p value = 0.0043) and also the Cit and Acet (n=29) and Cit Only group (n=48) (445 IU vs 112 IU, fdr adjusted p value = 0.0040).**

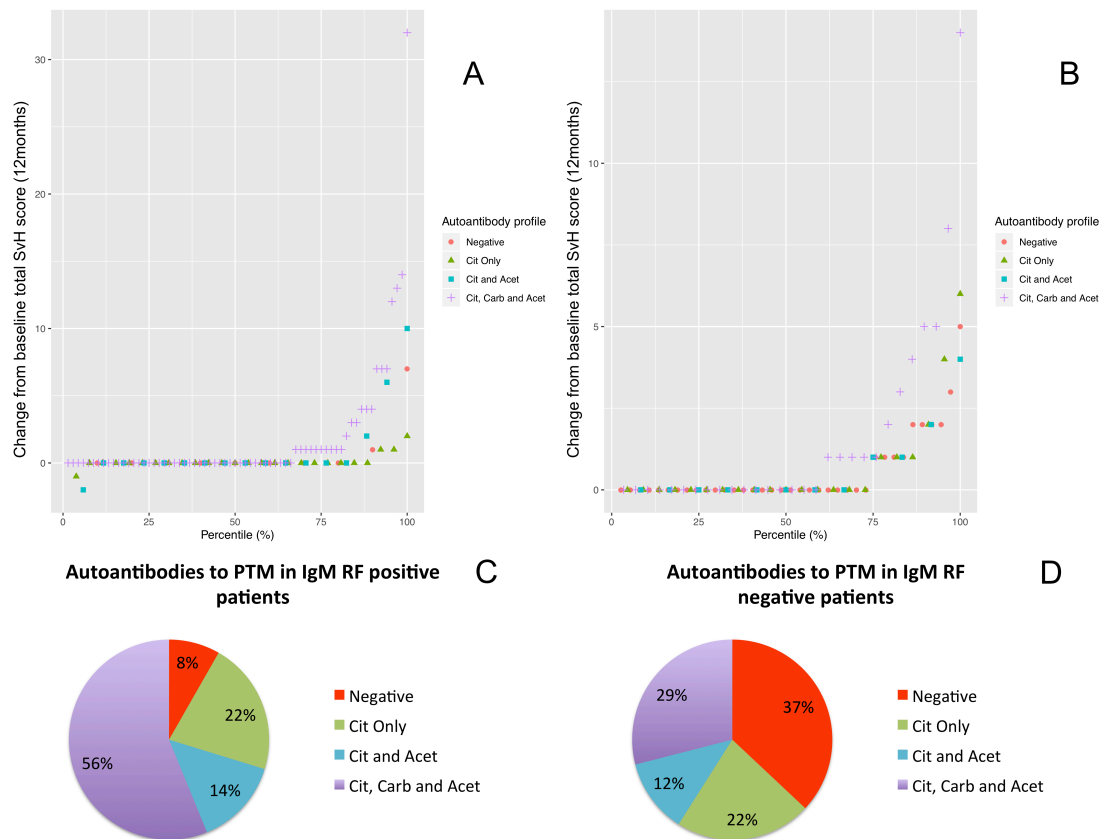


**Supplemental Figure 3: A: In the Cit only group, 9 patients had radiographic progression as defined by SDD and 39 patients did not. Anti CCP concentration is not statistically different between the patients with radiographic progression and those who do not in this subgroup (Wilcoxon,  $p=0.37$ ). B: In the Cit and Acet group, 7 patients had radiographic progression as defined by SDD and 22 patients did not. Anti CCP concentration is not statistically different between the patients with radiographic progression and those who do not in this subgroup (Wilcoxon,  $p=0.57$ ). C: In the Cit, Carb and Acet group, 35 patients had radiographic progression as defined by SDD and 62 did not. Anti CCP concentration is not statistically different between the patients with radiographic progression and those who do not in this subgroup (Wilcoxon,  $p=0.2$ ).**

	<b>Negative</b>	<b>Cit only</b>	<b>Cit and Acet</b>	<b>Cit, Carb and Acet</b>
IgM rheumatoid factor positive (n=121) no. (%)	10 (8.3)	26 (21.5)	17 (14.0)	68 (56.2)
IgM rheumatoid factor negative (n=100) no. (%)	37 (37)	22 (22)	12 (12)	29 (29)

**Supplemental Table 4. IgM rheumatoid factor was measured by ELISA from the serum of RA patients with a cut off of 20IU to determine antibody positivity.**





**Supplemental Figure 4A:** IgM RF positive patients with RA and autoantibodies to citrullinated, carbamylated and acetylated proteins (n=68) have higher SVH progression over one year compared to those who have autoantibodies to citrullinated proteins along (n=26) (estimated mean difference 1.2 95% CI 0.16–2.21). There is no statistical difference between Cit, Carb and Acet patients (n=68) and Negative patients (n=10) or between Cit, Carb and Acet (n=68) and Cit only patients (n=26). **B:** In IgM RF negative patients, no statistically significant differences were found when comparing SvH progression over one year in the subgroups Cit, Carb and Acet vs Cit only and Cit only vs Negative. **C:** The proportion of patients in each autoantibody grouping within RA patients who are positive for IgM RF **D:** The proportion of patients in each autoantibody grouping within RA patients who are negative for IgM RF.

Comparison	Estimated mean difference	Asymptotic lower 95% CI	Asymptotic upper 95% CI
<b>IgM Rheumatoid Factor Positive (n=121)</b>			
<b>Difference in Total SvH change between baseline and 12 months</b>			
Cit, Carb and Acet vs Cit Only	1.2	0.16	2.21
Cit, Carb and Acet vs Negative	1.0	-0.11	2.08
Cit Only vs Negative	-0.2	-1.05	0.64
<b>Difference in Erosion Score change between baseline and 12 months</b>			
Cit, Carb and Acet vs Cit Only	0.9	0.08	1.72
Cit, Carb and Acet vs Negative	0.8	-0.01	1.65
Cit Only vs Negative	-0.1	-0.63	0.46
<b>Difference in Joint Space Narrowing Score change between baseline and 12 months</b>			
Cit, Carb and Acet vs Cit Only	0.6	-0.19	1.40
Cit, Carb and Acet vs Negative	0.5	-0.22	1.23
Cit Only vs Negative	-0.1	-0.69	0.48
<b>IgM Rheumatoid Factor Negative (n=100)</b>			
<b>Difference in Total SvH change between baseline and 12 months</b>			
Cit, Carb and Acet vs Cit Only	1.3	-0.25	2.79
Cit, Carb and Acet vs Negative	1.1	-0.49	2.59
Cit Only vs Negative	-0.2	-1.15	0.71
<b>Difference in Erosion Score change between baseline and 12 months</b>			

Cit, Carb and Acet vs Cit Only	0·8	-0·25	1·83
Cit, Carb and Acet vs Negative	0·7	-0·34	1·78
Cit Only vs Negative	-0·1	-0·49	0·35
<b>Difference in Joint Space Narrowing Score change between baseline and 12 months</b>			
Cit, Carb and Acet vs Cit Only	0·6	-0·43	1·65
Cit, Carb and Acet vs Negative	0·5	-0·41	1·50
Cit Only vs Negative	-0·1	-0·71	0·58

**Supplemental Table 5** Estimated mean differences in radiographic progression scores for triple positive patients (Cit, Carb and Acet), single positive patients (Cit Only) and autoantibody negative patients summarised by RF IgM positive and negative status

Comparison	Estimated mean difference	Asymptotic lower 95% CI	Asymptotic upper 95% CI
<b>Difference in Total SvH change between baseline and 12 months</b>			
<b>Cit, Carb and Acet:</b> IgM RF positive v IgM RF negative	-0.2	-1.69	1.36
<b>Cit:</b> IgM RF positive v IgM RF negative	-0.1	-0.58	0.43
<b>Negative:</b> IgM RF positive v IgM RF negative	-0.1	-0.76	0.56
<b>Difference in Erosion Score change between baseline and 12 months</b>			
<b>Cit, Carb and Acet:</b> IgM RF positive v IgM RF negative	0.2	-1.09	1.42
<b>Cit:</b> IgM RF positive v IgM RF negative	0.0	-0.22	0.32
<b>Negative:</b> IgM RF positive v IgM RF negative	0.1	-0.32	0.45
<b>Difference in Joint Space Narrowing Score change between baseline and 12 months</b>			
<b>Cit, Carb and Acet:</b> IgM RF positive v IgM RF negative	0.0	-1.13	1.03
<b>Cit:</b> IgM RF positive v IgM RF negative	0.0	-0.46	0.37
<b>Negative:</b> IgM RF positive v IgM RF negative	0.0	-0.49	0.48

**Supplemental Table 6** Estimated mean differences in radiographic progression scores for RF positive patients and RF negative patients summarised by triple positive patients (Cit, Carb and Acet), single positive patients (Cit Only) and autoantibody negative.