

# SIZE OF KNEE OSTEOPHYTES IS UNDER-ESTIMATED AS ASSESSED BY MRI USING CT AS A REFERENCE STANDARD

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## BACKGROUND AND PURPOSE

- Radiographic diagnosis of knee OA is based on presence of a definite osteophyte (OP) on the a.p. or p.a. radiograph
- OPs represent fibrocartilaginous and skeletal outgrowths localized at joint margins, but are also seen centrally, especially at the femoral notch
- Epidemiologic studies and clinical trials commonly employ MRI using standard clinical sequences
- OP assessment is one of the features included in whole organ ordinal OA grading
- Sequence protocols are based on triplanar fat suppressed T2- or proton density-weighted sequences with bony features as well as fibrous and lipomatous tissues appearing hypointense
- Potential underestimation of osteophytes on MRI
- CT considered modality of choice for mineralized structures such as OPs
- Aim was to explore diagnostic performance of routine MRI as used in observational studies and clinical trials of knee OA for the assessment of OPs in all three knee compartments and the femoral notch using CT as a reference standard

## METHODS

- The Strontium Ranelate Efficacy in Knee Osteoarthritis Trial (SEKOIA <sup>1,2</sup>) clinical trial explored effects of 3 years treatment with strontium ranelate in patients with primary knee OA
- All patients included in the current study participated in the CT sub-study of SEKOIA <sup>3</sup>
- Baseline data from three different centers were used. All MR datasets were acquired with 1.5 T scanners
- CT data were acquired on Siemens Sensation 4, Siemens Volume Zoom or Siemens Sensation 64 scanners
- Sagittal and coronal planes with 3 mm slice thickness were reformatted from axial CT images for comparability with MRI
- OPs were scored using a modified MOAKS scoring system in the patellofemoral (PFJ), the medial tibio-femoral (TFJ) and the lateral TFJ.
- Size was assessed from 0 to 3 in 18 locations (**Figure 1**)
- MRIs and CTs were scored with a 3 week time interval randomly presented regarding examination ID
- A radiologist with 18 years experience in ordinal grading of OA features on cross-sectional images performed the assessments (FWR)
- Descriptive statistics were used to describe differences in ordinal grading between CT and MRI
- Weighted-kappa statistics were employed to assess agreement between scoring using the two methods.
- Sensitivity, specificity, positive predictive value and negative predictive value as well as AUC measures of diagnostic performance were employed using CT as the reference standard.

## RESULTS

- Mean age of the randomized patients was 62.9 ±7.5 years with a majority of women (70%). Body mass index was 29.9±5.0 kg/m<sup>2</sup>
- 61 patients with available MRI and CT data were included
- Altogether 1098 locations were evaluated
- For the PFJ, MRI detected 100 (69%) of 145 CT-defined OPs with a w-kappa of 0.56 (95% CI [0.49-0.64])
- In the medial TFJ, MRI detected 133 (77%) of 172 CT-OPs with a w-kappa of 0.59 (95% CI [0.52-0.66])
- For the lateral compartment these numbers were 58 (68%) of 85 CT-OPs with a w-kappa of 0.43 (95% CI [0.32-0.54])
- Regarding disagreement, for the PFJ MRI underestimated OP size in 77 cases (21%) and over-estimated in 17 cases (5%). For the medial TFJ these numbers were 75 (20%) and 20 (5%), and for the lateral TFJ 56 (15%) and 21 (6%)
- Regarding diagnostic performance for any OP detection (OP defined as Grade 1 or higher), for the PFJ sensitivity for MRI was 0.71 and specificity 0.85, for the medial TFJ 0.91 and 0.67 and for the lateral TFJ 0.65 and 0.92 (Table 1A)
- Using grades 0 and 1 combined (defined as normal) vs. grades 2 and 3 as a cut-off, these numbers changed to 0.67 and 1.00 for the PFJ, to 0.48 and 1.00 for the medial TFJ and 0.70 and 1.00 for the lateral TFJ (Table 1B)
- The AUC for all 18 locations combined on a knee level was 0.97 for presence of using any OP as the cut-off, and 0.85 for grade 2 and 3 OPs vs. 0 and 1 defined as normal

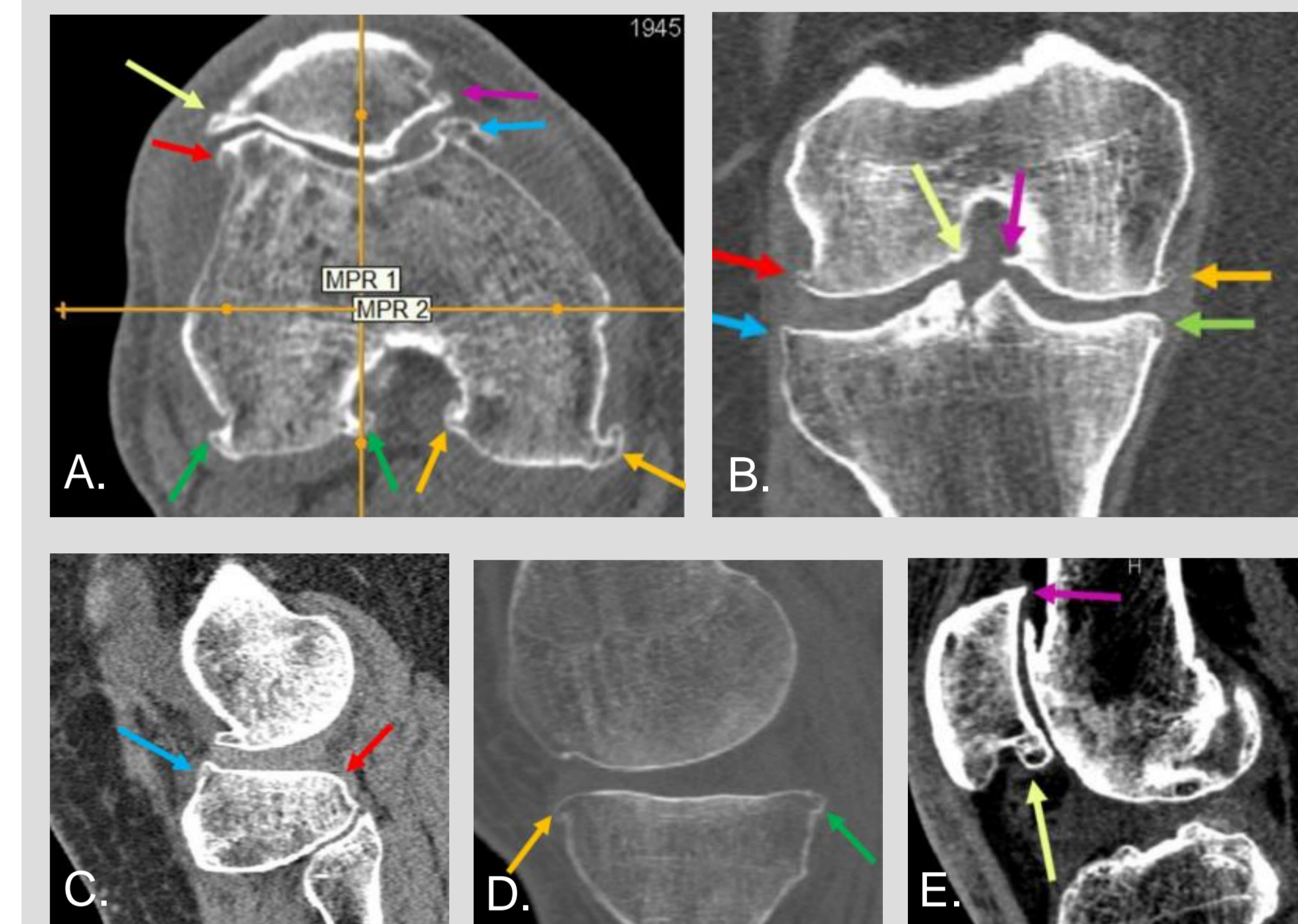
**Table 1.** Frequencies osteophytes on MRI and CT and diagnostic performance of MRI using CT as the reference standard

Osteophytes no OPs (grade=0) vs any OPs (grades 1-3)		n = 61						
		Frequency detected by MRI	Frequency detected by CT (ref standard)	Sensitivity	Specificity	Accuracy	PPV	NPV
ALL (18 locations)	yes	58	60	0.97		0.97	1.00	
	no	3	1		1.00			0.33
PFJ (6 locations)	yes	36	48	0.71		0.74	0.94	
	no	25	13		0.85			0.44
MTFJ (6 locations)	yes	54	58	0.91		0.90	0.98	
	no	7	3		0.67			0.29
LTFJ (6 locations)	yes	26	37	0.65		0.75	0.92	
	no	35	24		0.92			0.63

**A.** No OP (Grade 0) vs. ANY OP (Grades 1-3)

Osteophytes no OPs (grade=0-1) vs any OPs (grades 2-3)		n = 61						
		Frequency detected by MRI	Frequency detected by CT (ref standard)	Sensitivity	Specificity	Accuracy	PPV	NPV
ALL (18 locations)	yes	19	28	0.68		0.85	1.00	
	no	42	33		1.00			0.79
PFJ (6 locations)	yes	12	18	0.67		0.90	1.00	
	no	49	43		1.00			0.88
MTFJ (6 locations)	yes	12	25	0.48		0.79	1.00	
	no	49	36		1.00			0.73
LTFJ (6 locations)	yes	7	10	0.70		0.95	1.00	
	no	54	51		1.00			0.94

**B.** No and minor OP (Grades 0 and 1) vs. moderate-large OP (Grades 2 and 3)



**Figure 1.** Osteophytes were assessed in 18 locations: A. In the axial plane, the medial (purple arrow) and lateral patella (yellow arrow), the medial (blue arrow) and lateral (red arrow) anterior femur and the medial (orange arrows) and lateral (green arrows) posterior femur were assessed. Note that the larger osteophyte of two medial and lateral posterior femoral locations was counted. B. In the coronal plane the medial femur (orange arrow) and tibia (green arrow) and the lateral femur (red arrow) and tibia (blue arrow) were assessed. In addition the medial (purple arrow) and lateral (yellow arrow) notch was assessed. C./D. In the sagittal plane the lateral anterior (blue arrow) and posterior tibia (red arrow) and the medial anterior (orange arrow) and posterior tibia (green arrow) were evaluated. E. In addition, on a midline slice the superior (purple arrow) and inferior (yellow arrow) were assessed.

## CONCLUSION

- MRI underestimates presence and size of osteophytes in all 3 knee compartments.
- The sensitivity of >0.9 for OP detection in the medial compartment, which is commonly the compartment of relevance in clinical DMOAD trials, reflects that MRI is adequately able to detect osteophytes that commonly define structural disease
- However, CT may be helpful in assessment of small osteophytes particularly in early disease

## REFERENCES

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